March 4, 1958 C. WIDELL 2,825,407

GANG PUNCH

Filed March 24, 1955 4 Sheets-Sheet 1

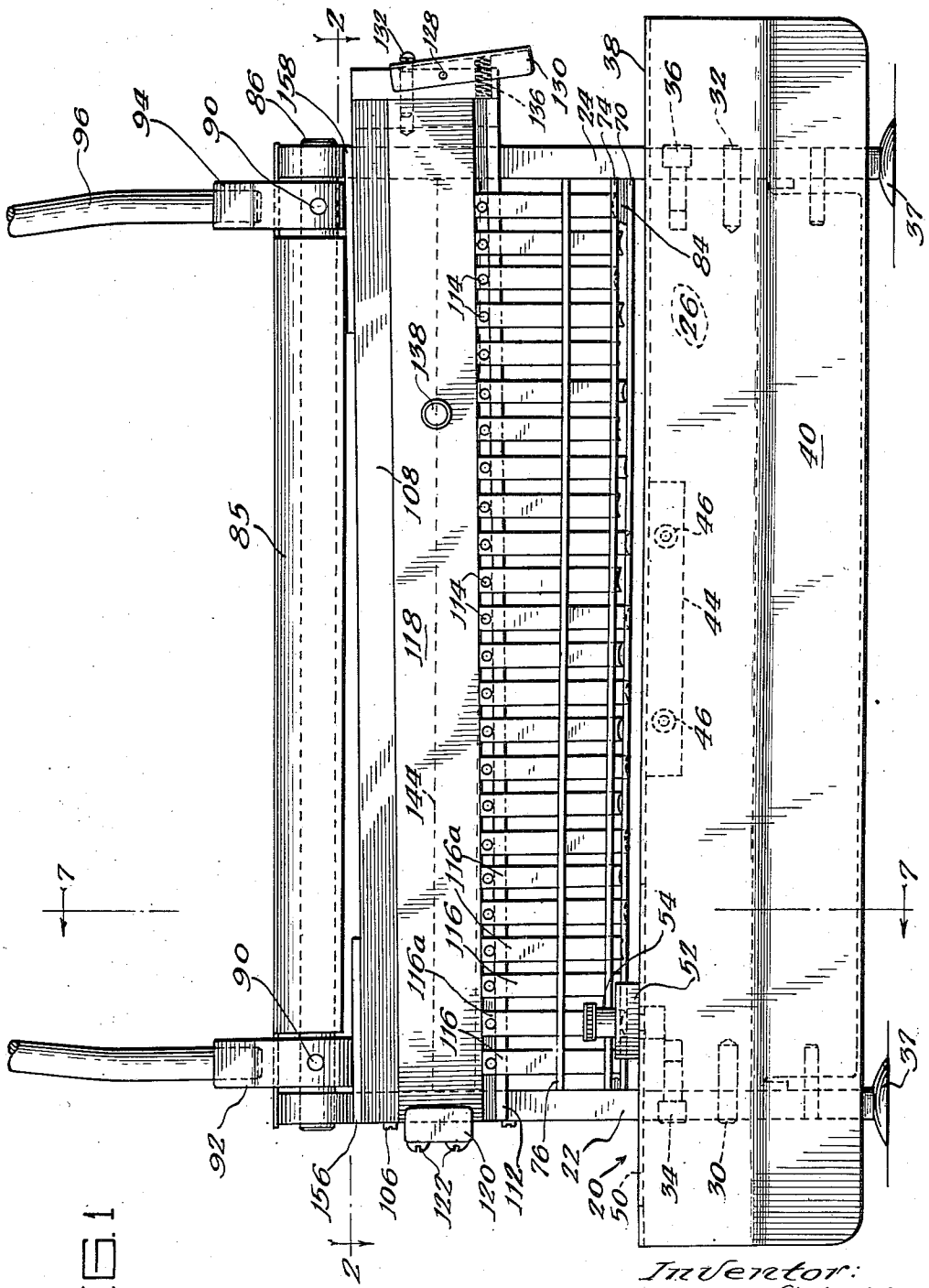


FIG. 1

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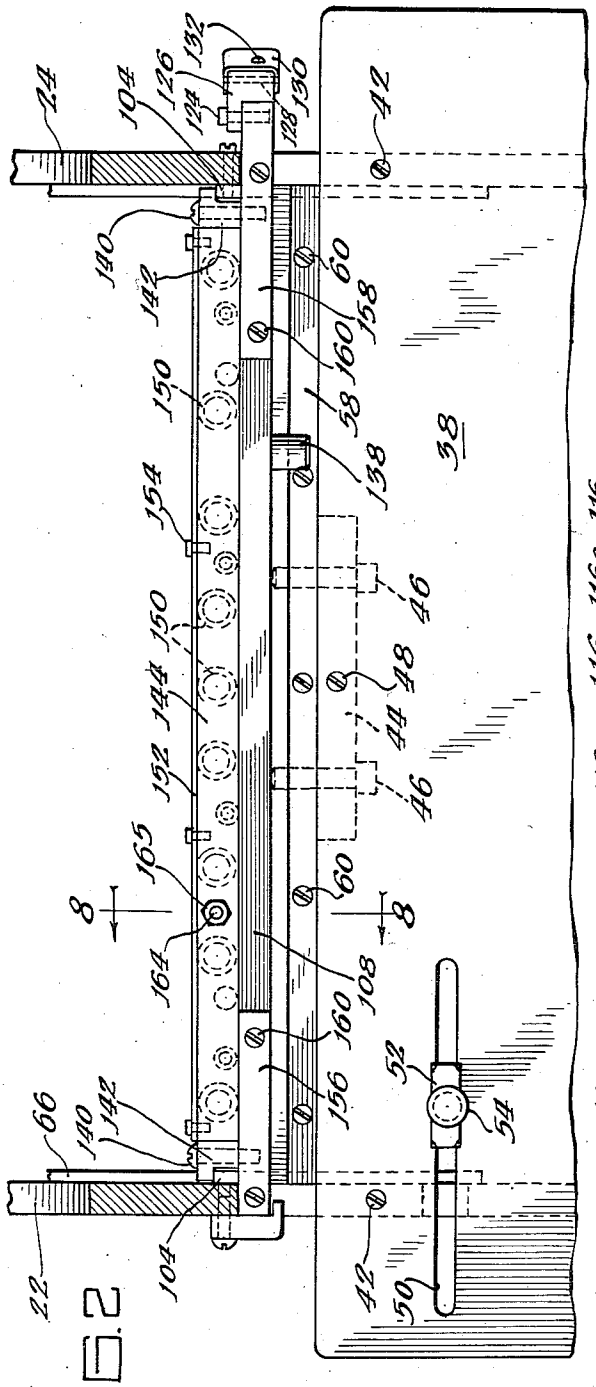


FIG. 2

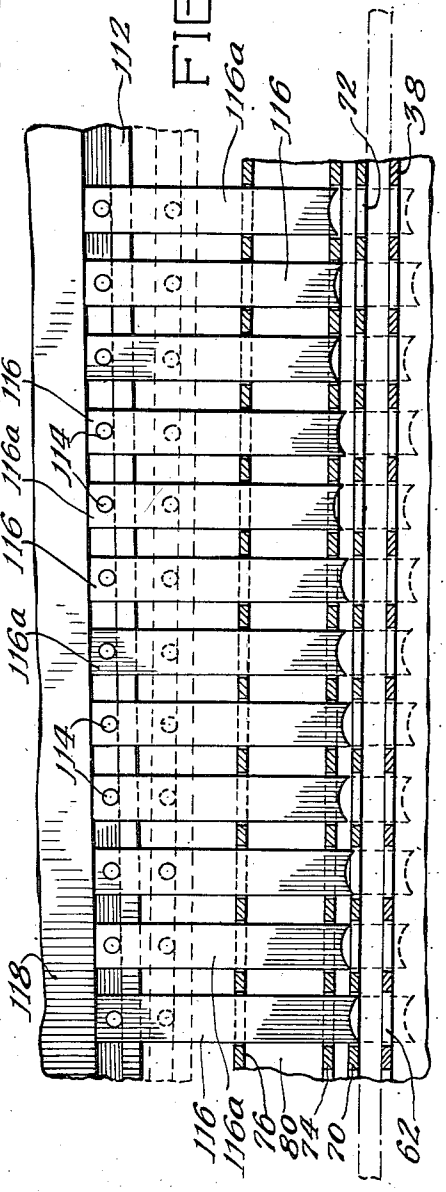


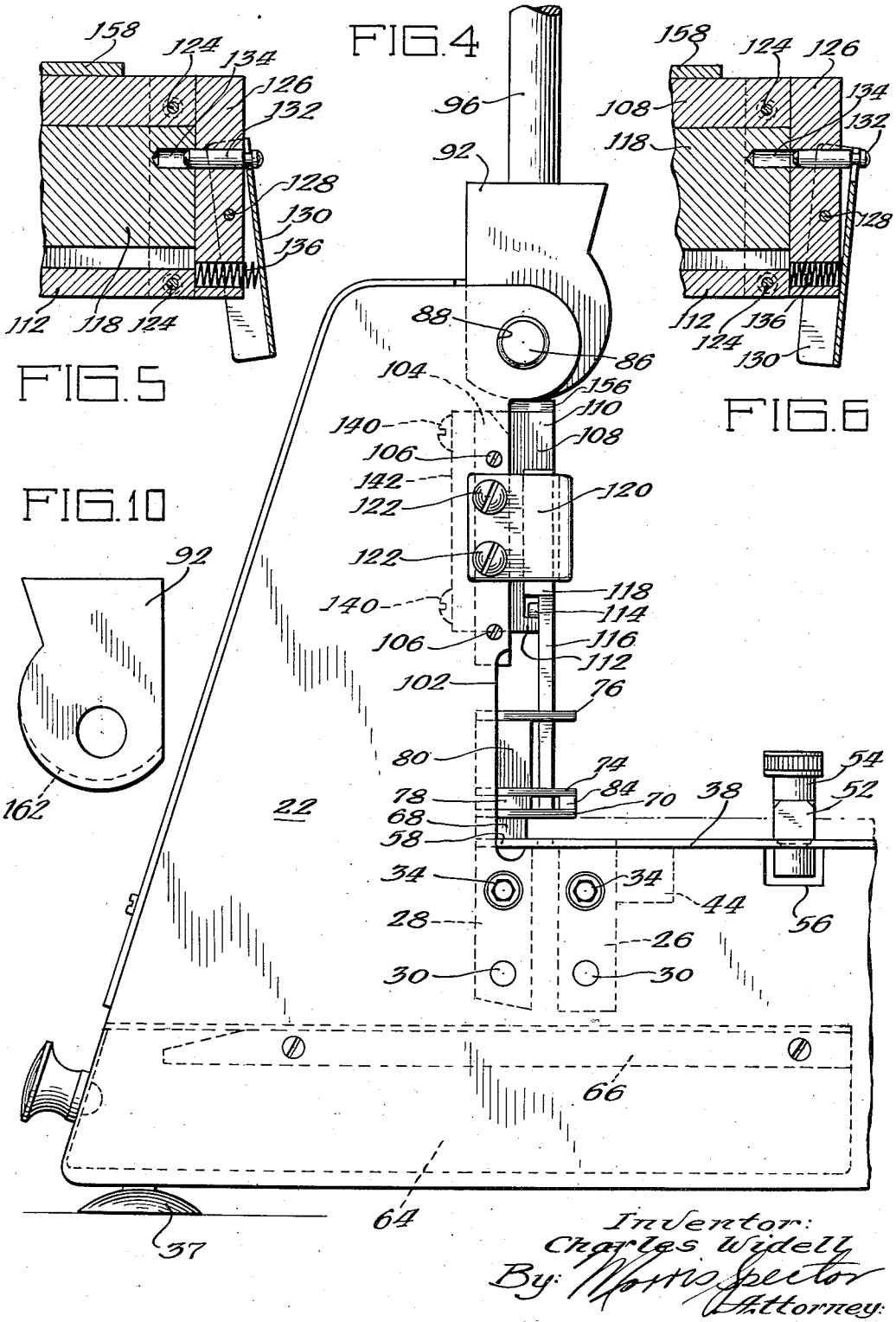
FIG. 3

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GANG PUNCH

Filed March 24, 1955 4 Sheets-Sheet 3



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March 4, 1958 C. WIDELL 2,825,407

GANG PUNCH

Filed March 24, 1955 4 Sheets-Sheet 4

FIG. 8

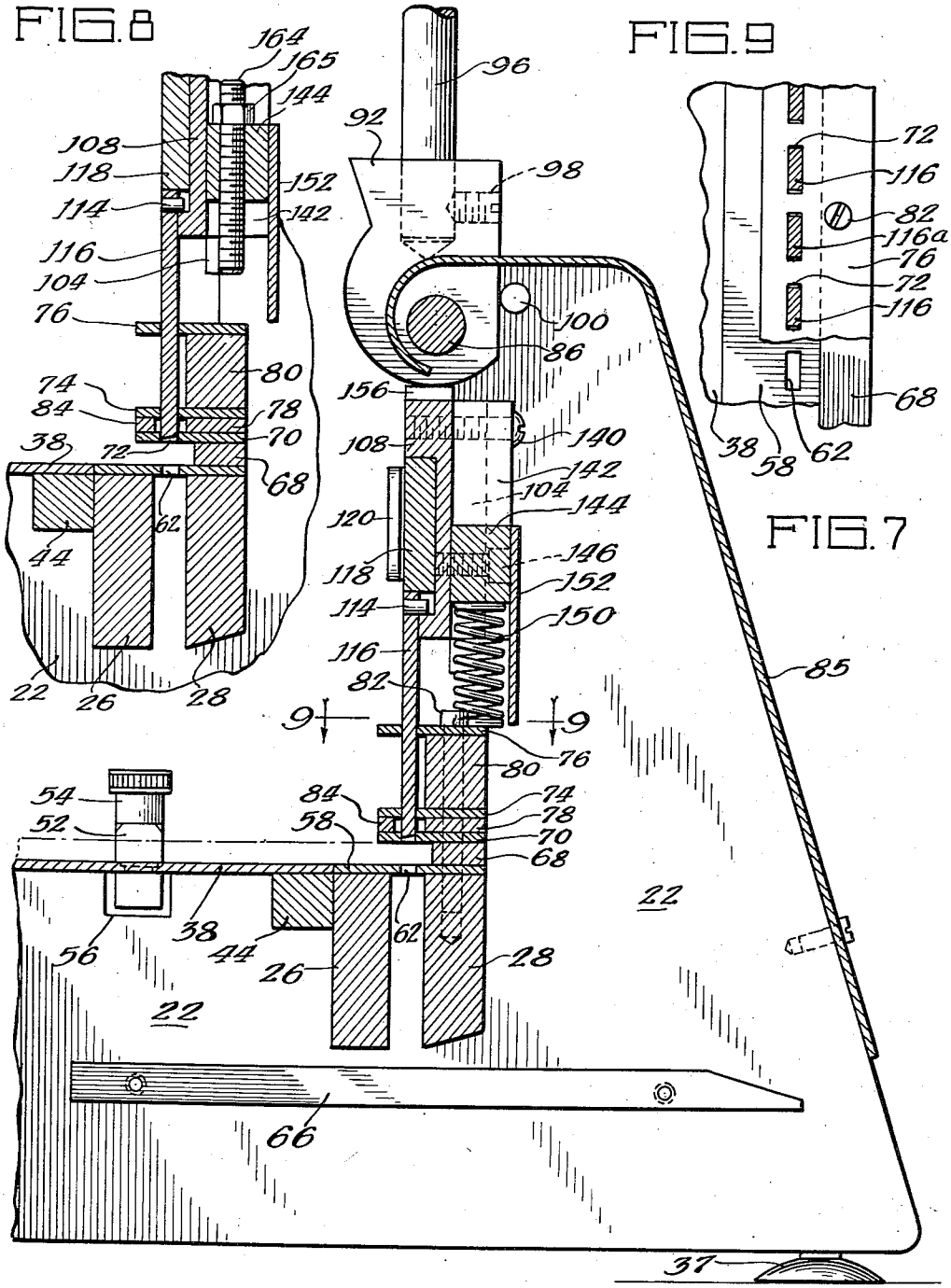


FIG. 9

FIG. 7

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GANG PUNCH

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Application March 24, 1955, Serial No. 496,560

1 Claim. (Cl. 164—124)

This invention relates to multiple perforating punches and is of particular utility in punches designed for perforating the edges of stacks of materials such as paper preparatory to binding the punched work-pieces in book form by means of suitable ring-type binders.

Where a long series of holes are to be cut in a single work-piece, whether of paper or of other materials, the effort required of the operator is, in conventional punches, in which all of the individual punch members strike the work-piece simultaneously, very high, since the entire effort of starting all of the individual perforations is concentrated at a single point in the stroke of the handle or other operating member which is manipulated by the operator. It is thus not uncommon to find that at one point in the stroke of the operating member of a conventional manually operated multiple perforating punch, the operator must place his entire weight on the operating member in order to drive the punch, particularly where unusually thick stacks of paper are being punched. Similar problems have been encountered in the multiple punching of metals by means of motor-driven punches, the motor in such cases being required to be of sufficient power to start all the holes in the work-piece simultaneously, unless provision is made for sequentially timed operation, which is in general relatively complex and expensive. In the case of such motor-driven punches for metals, there have been devised structures in which the punch members are of different lengths, so that as the punch-retaining member is driven toward the dies in a single stroke, the punch members penetrate the work-piece and the dies sequentially, rather than simutaneously, thus permitting a reduction in the strength of the motor and the mechanism, since the work performed in the stroke is distributed over the length of the stroke rather than being concentrated at a single point of punch impact. However, where a long series of holes or perforations are to be made, such a construction is extremely expensive, because of the large number of differing punch members required.

Further, the mere employment of punch members of differing length which has been used in the punching of metals is not satisfactory for the punching of materials such as paper, since it is found that additional problems are thereby introduced. In the case of punching paper and like materials, it is found that it is desirable to avoid excess travel of the punch member through the punched aperture in order to minimize deformation of the punched aperture by rubbing of the surface of the punch member against the edge of the punched aperture, both in forward and return motions of the punch member. Where the various punch members travel different forward and return distances through the stack of papers, the deformation becomes excessive as regards those of the punch members which travel furthest through the work-piece.

With these considerations in view, the most desirable single stroke relative motion between the punch members and the cooperating die openings is found to approximate the relative motion between the two blades of a scissors, i. e., a motion in which (in the open position) the line of the ends of the punch members and the line of the die openings form an acute angle, this angle diminishing to the point of parallelism as the punches are brought toward and into the die openings, so that at the end of the stroke the line of the ends of the punch members is parallel with the line of the die openings, all punch members having passed equal distances through their corresponding die openings.

However, the design of a multiple perforating punch having a relative motion between the punch assembly and the die assembly identical to that of the blades of a scissors, i. e., relative rotation about a fixed point, is impractical where the punch is designed to produce with a single stroke a long line of perforations through substantial thicknesses of stacked papers or similar materials. In order to permit the insertion of thick stacks of papers, such as checkbooks, catalogues, etc., into a punch having such a type of motion, the axis of rotation for the scissors action must be relatively remote from the punch members and their corresponding die openings, thus entailing an overall structure of dimensions grossly exceeding the space requirements of the punches and dies and of the paper being worked upon. Furthermore, to produce clean and identical perforations in perfect register through substantial stacks of paper, the motion of the punch members must at all times be perpendicular to the paper.

The present invention provides a multiple perforating punch in which the punch members are sequentially driven through the paper, all proceeding the same distance through the paper, without requiring excessive space for the machine. The relative motion of the punch assemby and the die assembly in the present invention simulates relative rotation about a remote axis, thus distributing the effort of punching of the paper through the stroke of the operating member. In addition, the punch members remain perpendicular to the work-pieces throughout the operation.

The present machine also provides for ready replacement of any of the punch members which may require such replacement, due either to wear, or to damage due to improper use of the machine. All of these advantages are obtained in a machine which is low in cost and highly reliable in operation.

Further objects and advantages, and the manner in which they are obtained, will be seen from the description of the single embodiment of the invention illustrated in the attached drawing, in which:

Figure 1 is a view in front elevation of a machine embodying the invention, the illustration of the operating member thereof being incomplete in part;

Figure 2 is a horizontal sectional view taken along the line 2—2 of Figure 1 in the direction indicated by arrows;

Figure 3 is an enlarged fragmentary view, partially in

section, illustrating the manner of cooperation of a punch assembly constituting a portion of the machine of Figure 1 with the die assembly thereof;

Figure 4 is an end view of the machine of Figure 1;

Figure 5 is a detailed view of a latch or lock assembly constituting a portion of the machine, the parts being illustrated in the normal or latched position;

Figure 6 is a view similar to Figure 5 but illustrating the parts in an unlatched position;

Figure 7 is a vertical sectional view taken along the line 7—7 of Figure 1;

Figure 8 is a detailed sectional view taken along the line 8—8 of Figure 2;

Figure 9 is a detailed sectional view taken along the line 9—9 of Figure 7; and

Figure 10 illustrates one of two cams employed in the machine and includes a dotted representation of the second cam, to illustrate the difference therebetween.

Referring to Figures 1, 2, 4 and 7 of the drawing, it will be seen that the base of the machine, generally designated **20**, is formed of end plates **22** and **24** joined by rectangular bars **26** and **28**, the latter being joined to the end plates **22** and **24** by dowel pins **30** and **32** and bolts **34** and **36**. Cushioned feet **37** are secured to the corners of the base. Overlying the front portion of the base **20** is a sheet-metal table **38**, the front portion of which is bent down to form a protective and decorative apron **40**, the table **38** being secured to the upper edges of the end plates **22** and **24** by screws **42**. Additional support for the central portion of the table **38** is provided by a bar **44** secured to the bar **26** by bolts **46**, the laterally central portion of the table **38** being affixed to the bar **44** by a screw **48**. A slot **50** in the top of the table acts as a slide for a paper stop **52** provided with a locking thumb screw **54**, the end plate **22** being notched at **56** to permit the paper stop **52** to slide beyond the end plate for the accommodation of extremely large papers.

Rearward of the table **38** on the base **20** is a die assembly comprising a unitary die plate **58** resting on the bars **26** and **28** and affixed to the bar **26** by screws **60**. The aligned rectangular die openings or apertures **62** in the die plate **58** appear over a space between the bars **26** and **28**, so that punchings from the paper or other work-piece fall into a drawer **64** supported on slides **66** at the bottom of the base.

Rearward of the die openings **62** atop the die plate **58** is a paper stop bar **68** which serves with the stop **52** to locate the stacked work-pieces in the punch. On top of the paper stop bar **68** is a guide plate **70** having punch guide apertures **72** similar to the die apertures **62**. Further identical guide plates **74** and **76** are spaced upwardly by spacers **78** and **80**, the entire punch guide assembly thus formed being maintained in position by bolts **82** extending through the assembly and threaded into the bar **28**. A supplementary spacer **84** opposite the spacer **78** aids in maintaining the spacing of the guide plates **70** and **74**.

The rear portions of the end plates **22** and **24** have integral upward extensions supporting the punch assembly and the drive therefor now to be described, a sheet-metal cover **85** covering the back of the machine. A shaft **86** is journaled in bearing apertures **88** at the top of the upwardly extending portions of the end plates, above and substantially spaced from the die plate **58**. Near the ends of this shaft are secured by means of locking pins **90** a left-hand rotary cam **92** and a right-hand rotary cam **94**. The cams are socketed to receive the ends of a generally U-shaped handle or operating member **96** (the central portion thereof being omitted from the drawing), the ends of the operating member **96** being retained in the cams by set screws **98**. The cams **92** and **94** are so pitched that their minimum downward radii occur when the handle or operating member **96** is essentially vertical, the downward radius of each cam increasing as the lever or handle **96** is brought forward and down to the horizontal position, the maximum downward radius being reached when the lever **96** has slightly passed beyond the horizontal position. Stops **100**, extending inward from the end plates **22** and **24**, fix the back-most position of the cams **92** and **94**, the position illustrated in the drawing. The front edges of the upstanding support portions of the end plates **22** and **24** are perpendicular to the table **38**, and to the die plate **58** and the guide assembly, the lower parts of these front edges being cut away at **102**. Affixed to the inner surfaces of the upper portions of the end plates are keys or slides **104**, secured by screws **106**. The keys or slides **104** serve to define a path of motion for the punch assembly now to be described in a plane perpendicular to the die plate **58**.

The carriage or punch-retaining member of the punch assembly is a generally rectangular bar **108**. Extending from the bar **108** along the top edge thereof is a forwardly extending flange **110**, and extending along the lower edge is a forwardly extending flange **112**, the latter protruding somewhat less than the former. Resting on the lower flange **112** are pins **114**, each pin **114** being force-fitted into a punch member **116** to form a protrusion thereon. The punch members **116** are of the general form of elongated rectangles, the lower ends thereof being formed with suitable curved and tapered ends to produce maximum efficiency in perforating papers and similar materials. The punch members **116** are seated for parallel motion in the guides **70**, **74** and **76**. Mounted on the punch-retaining member or carriage **108** between the upper flange **110** and the upper ends of the punch members **116** is an elongated bar **118** employed as a striker to drive the punches. The striker **118** is held in position at one end by a loosely fitting L-shaped bracket **120** secured to the end plate **22** by screws **122**, the bracket **120** being merely sufficiently tight against the striker **118** to keep the latter from falling out forward from the carriage **108**. At the opposite end of the carriage **108**, there is secured to the end of the carriage, by screws **124**, an end piece **126**. Pivoted on the end piece **126** by a pin **128** is a lever **130**. A fork formed at one end of the lever **130** engages the head of a latch-pin **132** which extends through an aperture in the end piece **126** into a corresponding bore **134** in the end of the striker **118**. A spring **136** seated in a suitable additional bore in the end piece **126** urges the lever **130** to the inward position wherein the inner end of the pin **132** engages the striker **118**. The latch thus constructed retains the right-hand end of the striker in position on the carriage. The striker is provided with a forwardly extending handle or knob **138**.

Fastened to the back of the punch-retaining member **108** at the ends thereof by means of screws **140** are guide-blocks **142** of L-shaped cross-section engaging the keys or slides **104**, which are mounted in stationary fashion on the end plates as described above. Sufficient lateral clearance is provided between keys **104** and guide-blocks **142** to permit slight rocking or rotation of the carriage in the plane of motion of the punches, as hereinafter described. There is thus defined for the punch assembly a path for motion toward and away from the guide assembly, permitting a small degree of rotation in the plane of motion.

On the vertically central portion of the back of the carriage or punch-retaining member **108** is a laterally extending bar **144** affixed by means of screws **146**. Compressed beneath the under surface of the bar **144** and the upper surface of the uppermost guide plate **76** are a series of coiled springs **150**. In order to maintain the springs **150** in position, a plate **152** is affixed to the back edge of the bar **144** by screws **154**.

It will immediately be seen that the springs **150** at all times urge the carriage assembly upward into contact

with the spaced cams 92 and 94. Hardened cam follower plates 156 and 158 are fastened to the upper edge of the carriage by screws 160. It will further be seen that the punch members 116, although pivoted and laterally slideable on the punch assembly, are securely locked in place on the assembly, being driven for motion toward the die assembly by the striker 118 and for motion away from the die assembly by the flange 112; but they may readily be removed upon unlatching (see Figures 5 and 6) of the striker, which permits removing the right-hand end of the striker and sliding the left-hand end of the striker out from behind the bracket 120 (the handle or knob 138 being grasped with the fingers for this purpose); upon complete removal of the striker in this manner, the individual punch members 116 may be removed and replaced at will. When the striker 118 is in position on the assembly, the punches 116, although merely hanging from the punch retaining member, cannot be removed therefrom because of their position in the punch guides, the upward motion of the punch assembly being limited so that they remain in the guides. However, upon removal of the striker 118, each individual punch member may be pulled upward sufficiently so that it is no longer held vertical by the guide assembly (which condition will occur when it is drawn upward sufficiently to clear the guide plate 74), at which point it may be removed and replaced by a similar punch member.

In Figure 10 is shown the left hand cam 92, and superimposed thereon is a dotted line 162 indicating the cam or pitch line of the right hand cam 94, the cams in other respects being identical. The cams have corresponding portions of unequal radius in the region of rest position of the handle, and corresponding portions of equal radius in the region of the end of the stroke of the handle, the cam 92 having a greater pitch than the cam 94. Under the urging of the springs 150, the difference in cam radius which exists in the rest position (the handle being upright), produces a tilt of the carriage or punch-retaining member 108 with respect to the stationary portion of the machine. As the operating member 96 is pulled forward and down around its axis, the carriage moves down toward the die assembly and simultaneously rotates slightly in the plane of the punch members, ultimately reaching a position at the end of its path where it is parallel to the die assembly, due to the identity of the cam shapes in the region corresponding to the end of the stroke of the operating member.

The effect produced by this combined translatory and rotational motion of the punch-retaining member will be seen to be roughly similar to the operation of a scissors, i. e., the effect in general simulates rotation of the punch assembly with respect to the die assembly about a relatively remote axis, although in fact the actual rotation occurs about a point on the carriage. It will be noted that the type of motion above described may be employed in structures wherein the punch members are rigidly and fixedly attached to the punch retaining or backing member. However, in such a case, the relative motion of the punch members with respect to the die members is not completely linear and perpendicular. In the present structure, the punch members are confined to linear perpendicular motion by the guide assembly, and the above-described manner of coupling the punch members to the punch-retaining member and the striker which drives the punch members permits slight sliding and pivoting of the punch members with respect to the rest of the punch assembly, thus permitting the punch members to remain perpendicular to the die assembly and parallel throughout their path, despite the slight rotation of the striker which produces cyclic, rather than simultaneous, perforation of the paper by the respective punch members, which are thus driven at speeds dependent on the distance of the portions of the striker abutting against them from the axis of rotation of the striker.

The stroke of the operating member produces successive perforations by all of the aligned punch members which are of equal length or extension from the carriage, starting at the left end of the machine and proceeding across to the right. The production of cyclic perforating action is further promoted in the present structure by alternation of the lengths of the punch members. As seen in Figure 3, the aligned punch members 116 are all of equal length. However, there are inserted between the punch members 116, to alternate therewith, punch members 116*a* of slightly shorter length. This structure adds substantially to the ease of operating the machine when large stacks are being punched. Assigning to the punch members in order from left to right the numbers 1, 2, 3, 4, 5, etc. (these numbers not appearing in the drawing), the long punch members bear odd numbers and the shorter punch members bear even numbers. As operation is commenced on a large stack, the order in which the perforations of the paper are commenced will start with 1, 3, 5, etc. At some point in this series, depending upon the thickness of the work-piece being punched, the even-numbered punch members will commence to make their perforations. Thus the overall order of operation might be 1, 3, 5, 2, 7, 4, 9, etc. This arrangement is particularly advantageous where the sheaf of papers being punched is very thick. The greatest separation between the commencements of the respective perforations occurs at the commencement of the stroke of the operating member, which is the point of the stroke at which the operator is limited to exerting a minimum of force on the operating member, because the operating member is at this point practically vertical. As the operating member reaches the portion of its stroke where operation is relatively easy because weight can be applied, the shorter punches come into operative engagement with the work-pieces, thus equalizing the effort of the operator over the entire stroke.

A stud 164 threaded through the bar 144 and provided with a lock-nut 165 abuts against the upper surface of the topmost guide plate 76 to constitute an adjustable limit stop fixing the lower end of the path of the punch-retaining member, and thus of the operating member. As seen in Figure 1, the bar 144 is mounted on the carriage or punch-retaining member 108 at a slight acute angle, so as to be parallel with the stationary portion of the assembly when the machine is in its rest position. This construction permits the use of identical springs 150, which would otherwise become unequalized due to differences in compression while in the rest or storage position.

It will be seen that the present construction provides a multiple punch in which the equalization of the effort required by the operator over the entire stroke of the operating member is maximized, while at the same time not adding to the size of the machine, and permitting a simple and inexpensive construction. Obviously, many variants of the specific structure shown and described will readily be made by persons skilled in the art upon understanding of the basic mode of operation and construction of the machine. Likewise, particular aspects of the invention may be applied to multiple punches far different in general construction and purpose from the paper punch herein described. Accordingly, the scope of the protection to be afforded the invention should not be limited by the particular embodiment illustrated, but is to be determined only from the appended claim.

What is claimed is:

Multiple perforating punch apparatus comprising a holder for punch members, said holder having a channel providing opposed support shoulders, individual punch members having projections thereon which are engaged by one of said shoulders when said holder is moved in one direction to move said punch members in said direction, a bar in said channel between said punch member projections and the other of said shoulders which bar bears against said punch member projections when the holder

is moved in the opposite direction to move said punch members in the latter direction, and means for removably retaining said bar in said holder channel comprising stop wall means at one end of said channel for retaining one end of said bar in place in said channel, and spring urged fastening means at the other end of said channel for releasably holding the other end of said bar in place, the release of said fastening enabling said bar to be slid out from said channel, and said punch members being removable from said holder when said bar has been removed therefrom.

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