Feb. 18, 1969

H. N. STAATS ETAL

3,427,914

PUNCH CONSTRUCTION

Filed Aug. 26, 1965

Sheet 1 of 3

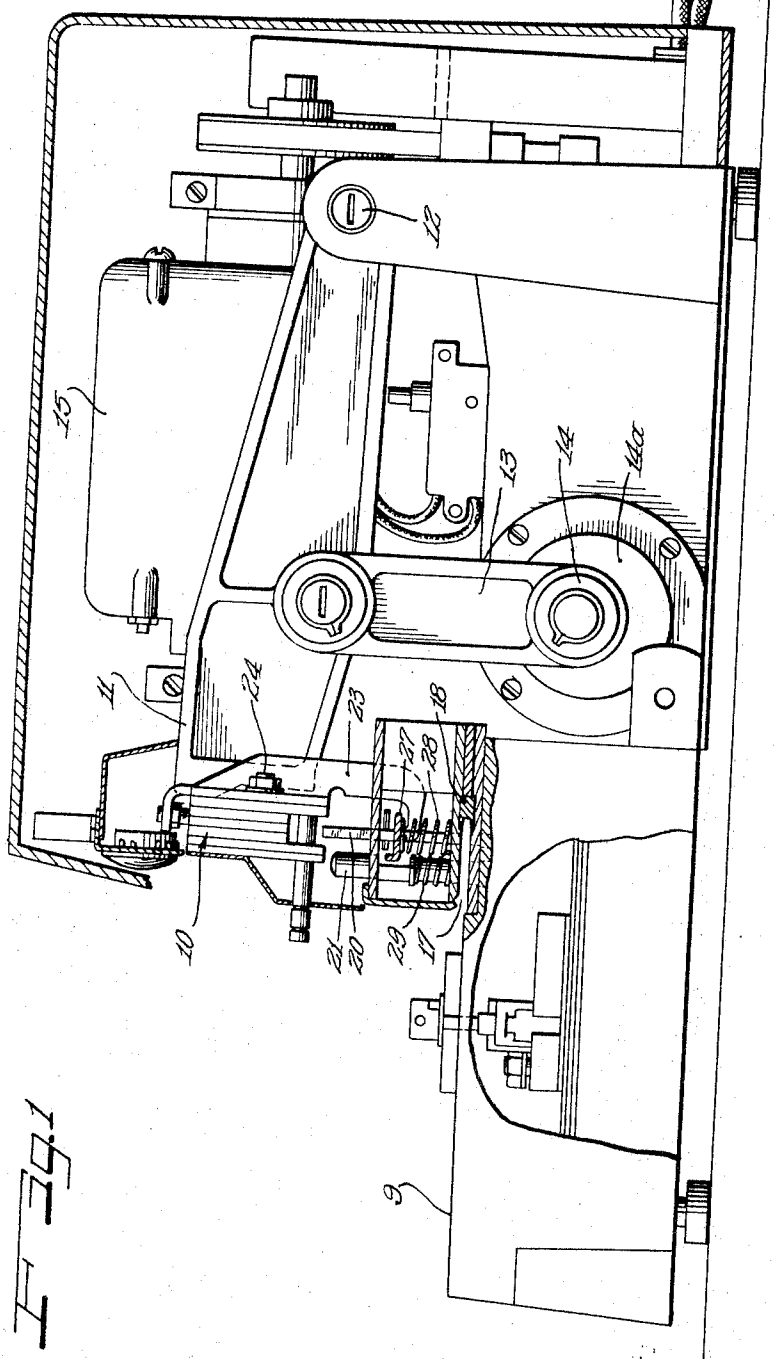


FIG. 1

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Sheet 2 of 3

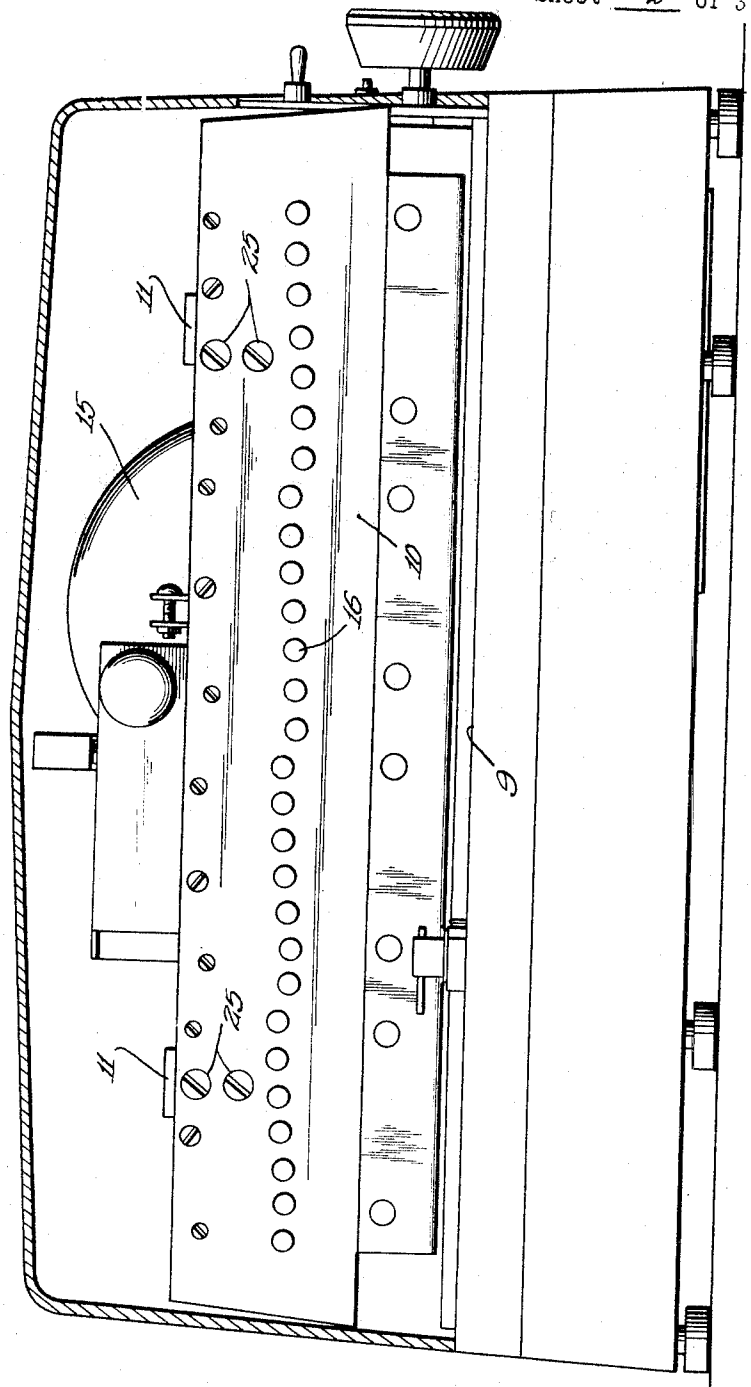


FIG. 2

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PUNCH CONSTRUCTION

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Fig. 3

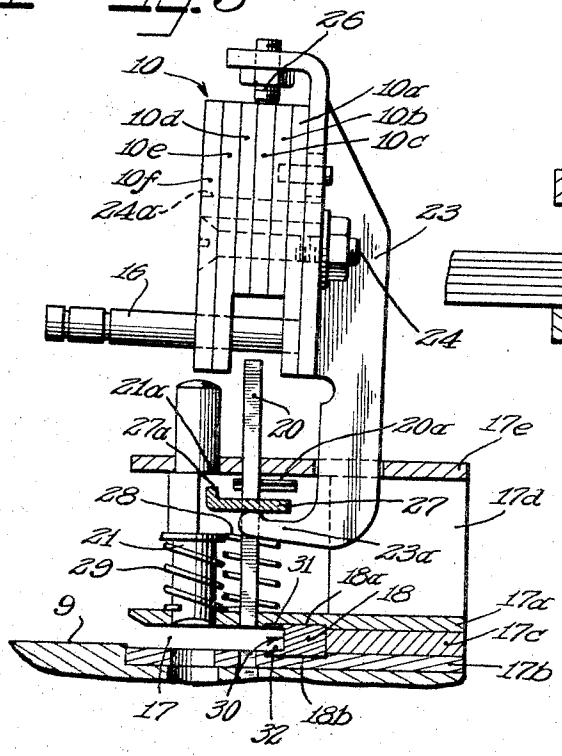


Fig. 5

PRIOR ART

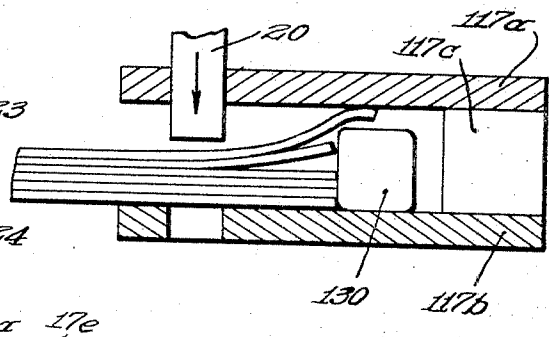


Fig. 6

PRIOR ART

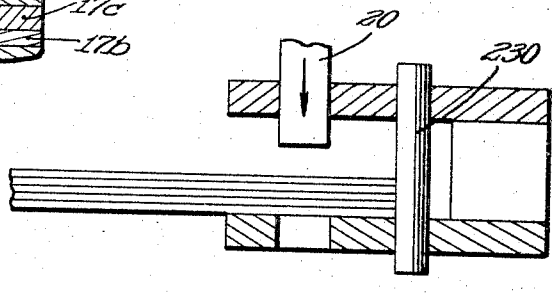


Fig. 4A

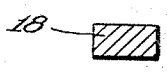
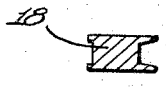


Fig. 4B



Fig. 4C



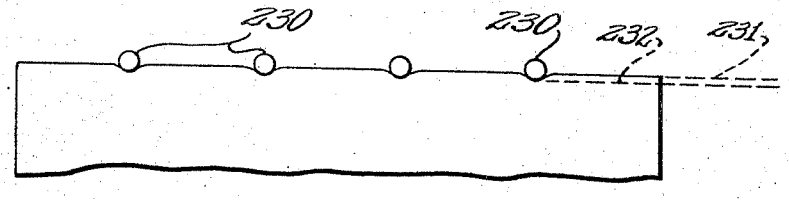


Fig. 7

PRIOR ART

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PUNCH CONSTRUCTION

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U.S. Cl. 83—467 6 Claims
Int. Cl. B26d 7/16; B26f 1/02

ABSTRACT OF THE DISCLOSURE

An improved punch apparatus and back-gauge construction providing jam-proof material backstop means and improved pressure bar construction providing increased machine versatility.

The present invention relates to an improved punching apparatus and is, more particularly, concerned with the provision of an improved die section and related components for use in manual or electrically operated paper punches and the like.

Paper punches have long been the cause of extensive experimentation and development programs designed to provide an inexpensive and yet rugged and efficient commercial grade punch. Such punch must be capable of substantially continuous operation over long periods of time and at the same time is preferably of a relatively low price. Perhaps even more important, the commercial punch must be capable of substantially instant servicing and be capable of adjustment through a relatively wide range. It has been found, as a result of such investigations, that prior art punches have not proved completely satisfactory for high volume production punching operations in several respects. Firstly, it has been found that the means for providing variations in paper size and positioning of the punched apertures have permitted wide inaccuracies in actual punching or have caused jamming of the paper relative to the punching die during paper movement. Secondly, adjustments and replacements of components of the punching bar mechanism have been difficult, if not impossible, with the machine in the field and in commercial operation. In accordance with the present invention, a novel and substantially improved gauge mechanism is provided for providing a wide range of paper positioning while at the same time providing jam-proof operation. Further, the invention provides an improved punching bar of a modular type which is built up of a large number of plates secured together in a manner permitting ready disassembly for modifications of the punching pattern or for replacement of worn components. These improved constructions have provided a new concept in punching die construction that has greatly reduced the cost of construction of the apparatus and has, as well, greatly reduced servicing time and the time heretofore required for setting up the punch for commercial operation. Additionally, the punch apparatus of the present invention provides substantially fool-proof punching operation wherein the paper or other articles being punched are prevented from jamming and are at the same time very accurately punched at high rates of speed.

In accordance with the present invention, a gauge is provided for adjusting the distance the paper is permitted to project into the punch opening. This comprises a removable bar forming a gauge surface facing the paper without providing any cracks or crevices into which one or more sheets can stick upon forward or sidewise paper movement. Similarly, in the present case, the punching bar is constructed of a multitude number of thin plates formed, preferably by simple and inexpensive stamping

steps, to provide the necessary contact surfaces and capable of simple rearrangement or the partial substitution of standard parts to provide different punching patterns. As a result of the present invention, accordingly, applicants have provided a commercial punch construction capable of handling and punching sheet materials at an extremely rapid rate without jamming and operative under heavy punching pressures without damage or deformation of any of the punch parts.

It is, accordingly, an object of the present invention to provide a modular die section for automatic punches or the like capable of a wide variation of punching patterns and capable of simple paper perforation position adjustment.

Another object of the present invention is to provide a simplified back gauge for machines adapted to the handling of paper or the like.

Another object of the present invention is to provide a punch employing a pressure bar of laminated configuration.

A feature of the invention resides in the provision of a continuous back gauge having a vertical dimension substantially greater than the vertical height of a paper-accommodating punch opening and presenting solely a vertical dimension to the paper.

A feature of the invention resides in the provision of a one-piece completely uninterrupted, jam-proof back gauge.

A further feature of the invention resides in the provision of a readily modifiable commercial duty punch pressure bar.

Still other objects and features of the present invention is the provision of a simple, widely adjustable commercial punch.

Still other and further objects and features of the present invention will at once become apparent from a consideration of the attached specification and drawings wherein a preferred embodiment of the invention is shown by way of illustration only and wherein:

FIGURE 1 is a side-elevational view of an electric powered commercial type punching machine embodying the present invention;

FIGURE 2 is a front elevational view of a machine illustrated in FIGURE 1 further illustrating the arrangement of applicants' punch construction;

FIGURE 3 is an enlarged side-elevational view of the punch pressure bar and modular die section as shown in FIGURE 1;

FIGURE 4*a* is an end view, in cross-section, of a back gauge bar substitutable for the bar shown in FIGURES 1 and 3;

FIGURE 4*b* is a cross-sectional, end-elevational view of a modified back gauge bar;

FIGURE 4*c* is a still further modified form of back gauge bar shown in cross-section;

FIGURE 5 is an end elevational view, shown schematically, of one prior art form of back gauge construction in operation;

FIGURE 6 is an end-elevational view shown, schematically, of a back gauge construction, also known in the prior art;

FIGURE 7 is a plan view, also shown schematically, of the prior art configuration illustrated in FIGURE 6.

As shown on the drawings:

As may be seen from a consideration of FIGURES 1 and 2, the power-operated punch configuration of the present invention comprises generally a vertically reciprocal punch pressure bar **10** secured to a pair of pivoted arms **11** oscillatable about pivots **12** by means of connecting rods **13** moved in a generally vertical direction by rotatable eccentrics **14** cyclically rotated by an elec-

trical motor **15** or the like. Eccentrics **14** may be staggered in their angular relationship to the drive motor **15** with respect to the two arms **11** to provide a wave action motion and/or the individual punch actuating pins **16** described more fully below may be positioned in a wave configuration as clearly shown in FIGURE 2. Paper or similar material to be punched is laid upon the table **9** for introduction into the gap **17** against back gauge **18** for perforation by reciprocal punch members **20** and **21**.

The mechanical details of the modular die construction may be very clearly seen from FIGURE 3. As there shown, the pressure bar **10** is composed of a plurality of laminate plates **10***a* through **10***f*. In a power punch as shown, the laminates are bolted together into a rigid assembly with stripper bar arms **23** by means of bolts **24** and dowel pins **24***a*, and are, similarly, rigidly secured to the control arms by bolts **25**. Close tolerance holes in plates **10***a* through **10***f* assure very accurate alignment of the complete bar. The exact position of the stripper arms **23** is determined relative to the pressure bar **10** by way of an adjusting set screw **26** such that the extending ends **23***a* of the stripper arms co-operate with the stripper bar **27** through which all of the punches **20** pass to provide lifting motion for the punches **20** upon vertically upward movement of the pressure bar **10** after punching operation. This provides positive stripping action in addition to the spring bias provided by individual springs **28** surrounding each of the pins **20**. For this purpose each of the pins **20** has a press pin **20***a* fitted above the pressure bar **27**. Punches **20** are individually actuated by horizontally disposed pins **16**.

As discussed above, the actuation of punches **20** may readily be accomplished by means of a laminate comprising elements **10***a* through **10***f*. However, it has been found in some instances desirable to incorporate additional punches, either in the rectangular shape of the punches **20**, or in a round shape of punches **21**. Such punches may be accommodated in accordance with the present invention very simply by adding laminate **10***f*. Such laminates **10***f* may be one or more in number and cause the pressure bar **10** to extend out over the upper ends of the additional punch members **21** for actuation thereof against the pressure of punch springs **29**. Positive stripping is provided by shoulders **21***a* co-operating with edge **27***a* of bar **27**. As may be seen, accordingly, a very wide variation of punch designs may be accommodated in an extremely simple way by adding or deleting laminations from the pressure bar **10**. Manifestly, such additions or deletions may be readily accomplished in the field. It has been found, additionally, that construction of the bar **10** by means of laminates provides an extremely inexpensive construction requiring no broaching or heavy drilling equipment. This is true since the plates may on an individual basis readily be accurately punched to provide for passage of the pins **16** and bolts **24**, **25**.

The paper resting upon table **9** is introduced, as shown in FIGURE 3, into position underneath the punches **20**, **21**, and against back gauge **18**. The back gauge **18** provides a positive stop which is jam-proof. This will readily be understood when it is realized that the back gauge **18** extends the full length of the pressure bar **10** with a constant cross-section. The vertical height of the gauge **18** is substantially greater than the width of the throat **17** between plates **17***a* and **17***b*. This is accomplished by providing grooves **18***a* and **18***b* in the respective plates **17***a* and **17***b*. The back gauge may comprise a rectangular cross-section as shown in FIGURE 4*a* or may take any of the forms shown in FIGURES 3, 4*a*, 4*b*, and 4*c*, or variations thereof. As illustrated in FIGURE 3, for example, the groove **30** of the back gauge **18** is provided with tapered walls **31** and **32** which are thinner in their vertical dimension at the front edge of the slots **18***a* and **18***b* than the depth of the slots. This provides for a relief such that paper passing toward the back gauge cannot engage the front, or left-hand edge as viewed in FIGURE 3, of the back gauge. Since the back gauge **18** is substantially greater in dimension than the width of the throat **17**, it is impossible for the paper or material being punched to pass around the back gauge. Accordingly, the paper is positively positioned in a confined manner.

The importance of the control of the paper being punched, in the manner established by the simple back gauge of the present invention, will be more fully understood from a consideration of FIGURES 5, 6 and 7. These figures illustrate, schematically, structures employed widely in the prior art. FIGURE 5 illustrates a movable back gauge **130** of generally rectangular cross-section and designed, within manufacturing tolerances, to fill the space between plates **117***a* and **117***b*. Unfortunately, in order to permit longitudinal removal of a back gauge bar such as **130** from such a construction, slight tolerance is required. This tolerance means that the back gauge bar **130** is slightly smaller in vertical height than the spacer **117***c*. In practice it has been found that the top sheet very often squirms over the top, at least in part, of the back gauge bar **130** causing a paper jam and inaccurate punch. Such back gauge bars, although seemingly satisfactory, have proved unsatisfactory in usage with commercial automatic punching mechanisms where paper jams cannot be tolerated.

Similarly, back gauges have been constructed in prior art devices employing a plurality of pins **230**. The provision for adjustment of position of such pins has been difficult and, additionally, in mass production operation designed for high volume, the handling of large quantities of paper at high speeds has caused buckling of the paper around the pins, as may be seen from FIGURE 7, causing an inaccurate punching. Such inaccurate punching occurs from the fact that the true locating line of the leading edge of the paper, indicated at **231** is different from the actual locating line **232** by a few thousandths of an inch due to the bulging of the paper under insertion loads. This "bulging" also can cause a jam if the paper is removed sideways in a direction longitudinally of the row of pins.

The failures of the prior art are completely overcome by the structure of the present invention. Although means have been suggested for curing the defects above noted, to applicants' knowledge, the system of the present invention is the first fully accomplishing a jam-proof device capable of handling extremely rapid paper feed. Due to the fact that the back gauge bar **18** completely fills the space between the plates **17***a* and **17***b*, even though tolerances are provided between the bar and the grooves **18***a*, **18***b*, to permit longitudinal sliding motion of the bar, the paper can under no circumstances move above or below the back gauge bar. Similarly, the complete continuity of the bar throughout its length prevents catching of paper corners or indentation of the paper. Accordingly, it has been found that extremely accurate punching has been accomplished. Further, an extremely simple adjustment of the back gauge dimension is accomplished by providing a plurality of variously grooved back gauge bars. These bars may readily be slid into position in the punch and permit almost an infinite variation of back gauge dimension. In order to assure free sliding fit of the back gauges into the modular die sections, the die sections, which comprise the plates **17***a*, **17***b*, **17***c*, **17***d* and **17***e*, are made of a length approximating the length of the pressure bar **10** and the back gauges **18**. While such die sections have in the past ordinarily been of a relatively short length, for example four separate short lengths in the case of prior punches of the size illustrated, integration of such die sets into a single long set has permitted absolute alignment of the grooves **18***a* and **18***b* permitting simple insertion of the gauge **18** under all circumstances.

It will be seen from a consideration of the above specification in connection with the drawings, that we have provided an extremely versatile punch construction which is jam-proof even under circumstances in which the paper

being punched is inserted at a high rate of speed transversely against the back gauge and is subsequently discarded longitudinally of the back gauge. Additionally, the plate components may be constructed of simple sheet stampings permitting wide variations in punching actuation by the pressure bar **10**. In actual practice, the spacers **17***d* and **17***c* are inexpensive standard aluminum extrusions made to inexpensive tolerance on the order of .005". These loose tolerances do not adversely affect the back gauge of this invention since slight looseness of the gauge is of no consequence as in prior devices. Similarly, the gauge bar **18** may preferably comprise a simple extrusion of aluminum, plastic, or like materials. It will, of course, be clear to those skilled in the art that variations and modifications may be made in the structure illustrated without departing from the scope of the novel concepts of our invention. Accordingly, it is our intent that the scope of the present invention be limited solely by that of the hereinafter appended claims.

We claim as our invention:

1. In combination, a modular die set for punching sheet material, means in said die set for supporting a plurality of rows of punches in spaced relation, at least one row of punch members supported in said support means for perforating said sheet material with a plurality of apertures adjacent one edge thereof, said support means supporting and guiding said punch members for generally vertical movement thereof, a pressure bar, means moving said pressure bar generally vertically in alignment with said punch members for vertical movement thereof in the punching direction, a pair of spaced surfaces defining a throat for said sheet material in the path of movement of said punch members, back gauge means defining an abutment for controlling the position of said sheet material, said pressure bar comprising a plurality of stamped plates separably laminated in the generally vertical plane to a width extending over one or more rows of said punch members and secured to means for moving the bar in the generally vertical plane.

2. A punch for piercing a plurality of sheets of material with a row of apertures comprising a row of punch members, means for supporting and guiding said punch members for movement generally perpendicular to said sheets, a pair of spaced surfaces defining a throat for said sheets of material, back gauge means defining an abutment between said spaced surfaces for positioning said sheets of material in the path of movement of said punch members in a predetermined position relative thereto, said spaced surfaces having longitudinally extending recesses facing each other, and back gauge means slidably inserted into said recesses, said back gauge means comprising a bar having a dimension facing said sheets which is greater than the width between said spaced surfaces, said bar extending into said longitudinally extending recesses of spaced surfaces and positioned closely adjacent the edges of the recesses at the surfaces of the throat whereby movement of said sheets around said bar is prevented.

3. A punch for piercing a plurality of sheets of material with a row of apertures comprising a row of punch members, means for supporting and guiding said punch members for movement generally perpendicular to said sheets, a pair of spaced surfaces defining a throat for said sheets of material, back gauge means defining an abutment between said spaced surfaces for positioning said sheets of material in the path of movement of said punch members in a predetermined position relative thereto, said spaced surfaces having longitudinally extending recesses facing each other, and back gauge means slidably inserted into said recesses in a direction longitudinal of said row, said back gauge means comprising a bar extending throughout the length of said row and having a dimension facing said sheets which is greater than the width between said spaced surfaces, said bar extending

into said recesses of said spaced surfaces and positioned closely adjacent the edge of said recesses whereby movement of said sheets around said bar is prevented, said bar having a longitudinally extending groove in the surface thereof facing said sheets for providing a predetermined depth of movement of said sheets into said throat.

4. A punch for piercing a pluarlity of sheets of material with a row of apertures comprising a row of punch members, means for supporting and guiding said punch members for movement generally perpendicular to said sheets, a pair of spaced surfaces defining a throat for said sheets of material, back gauge means defining an abutment between said spaced surfaces for positioning said sheets of material in the path of movement of said punch members in a predetermined position relative thereto, said back gauge means comprising a bar extending throughout the length of said row and having a dimension facing said sheets which is greater than the width between said spaced surfaces, said bar extending into said spaced surfaces whereby movement of said sheets around said bar is prevented, said bar having a longitudinally extending groove in the surface thereof facing said sheets for providing a predetermined depth of movement of said sheets into said throat, said bar being longitudinally freely slidable for insertion and removal in said punch.

5. A punch for piercing a plurality of sheets of material with a row of apertures comprising a row of punch members, means for supporting and guiding said punch members for movement generally perpendicular to said sheets, a pair of spaced surfaces defining a throat for said sheets of material, back gauge means defining an abutment between said spaced surfaces for positioning said sheets of material in the path of movement of said punch members in a predetermined position relative thereto, said back gauge means comprising a bar extending throughout the length of said row and having a dimension facing said sheets which is greater than the width between said spaced surfaces, said bar extending into said spaced surfaces whereby movement of said sheets around said bar is prevented, said bar being longitudinally freely slidable.

6. In combination, a modular die set for punching sheet material, a plurality of rows of punch members for perforating said sheet material with a plurality of apertures adjacent one edge thereof, means supporting and guiding said punch members for generally vertical movement thereof, a pressure bar, means moving said pressure bar generally vertically in alignment with said punch members for vertical movement thereof in the punching direction, a pair of spaced surfaces defining a throat for said sheet material in the path of movement of said punch members, back gauge means defining an abutment extending longitudinally of said pressure bar and the row of punches and extending between said spaced surfaces and into said spaced surfaces to provide an abutment surface of greater thickness than the dimension between said spaced surfaces to thereby provide an impenetrable barrier to all of said sheets, said pressure bar comprising a plurality of stamped plates separably laminated to a width extending over all of said rows of punches for actuation of all of said punch members and separable to leave a bar extending over less than all of said rows of punch members.

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U.S. Cl. X.R.

77—55; 83—571, 620