United States Patent

[11] 3,578,761

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[54] **SEVERING APPARATUS**
13 Claims, 7 Drawing Figs.

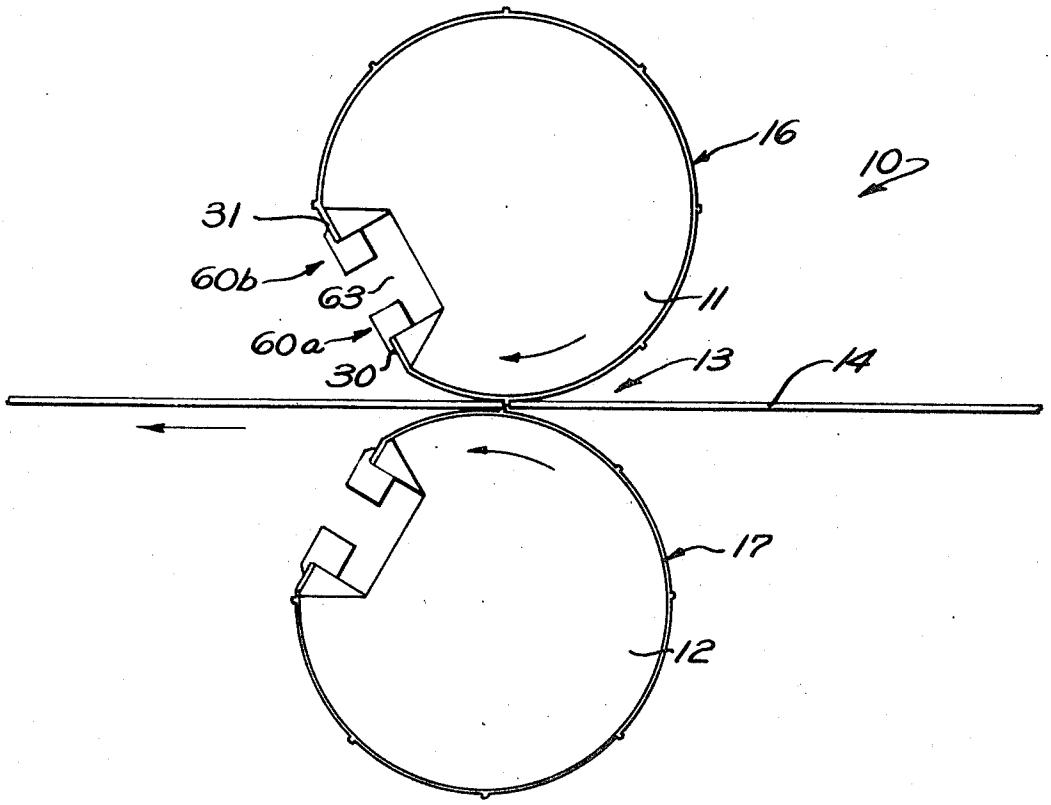
[52] **U.S. Cl.** **83/343,** 83/665, 83/678, 83/698, 93/58.2
[51] **Int. Cl.** **B23d 25/12,** B26d 1/56
[50] **Field of Search** 83/343, 345, 663, 665, 678, 698; 93/58.2, 58.3, 58

[56] **References Cited**
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1,777,285	1930	Adsit	93/58.2
2,682,208	1954	Monroe et al.	93/58.2X
3,383,991	1968	Sarka	93/58.2

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ABSTRACT: Apparatus for severing material at selected locations comprises first and second dies. Each of the dies has sheet-severing elements in the form of narrow projections extending above the surface of the main body of the respective die. The sheet-severing elements define a layout of the selected material locations to be severed. At least one of the dies comprises a plurality of separate discrete die sections. An additional die section is provided as a replacement for each die section in the event of damage thereto.



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SHEET 1 OF 3

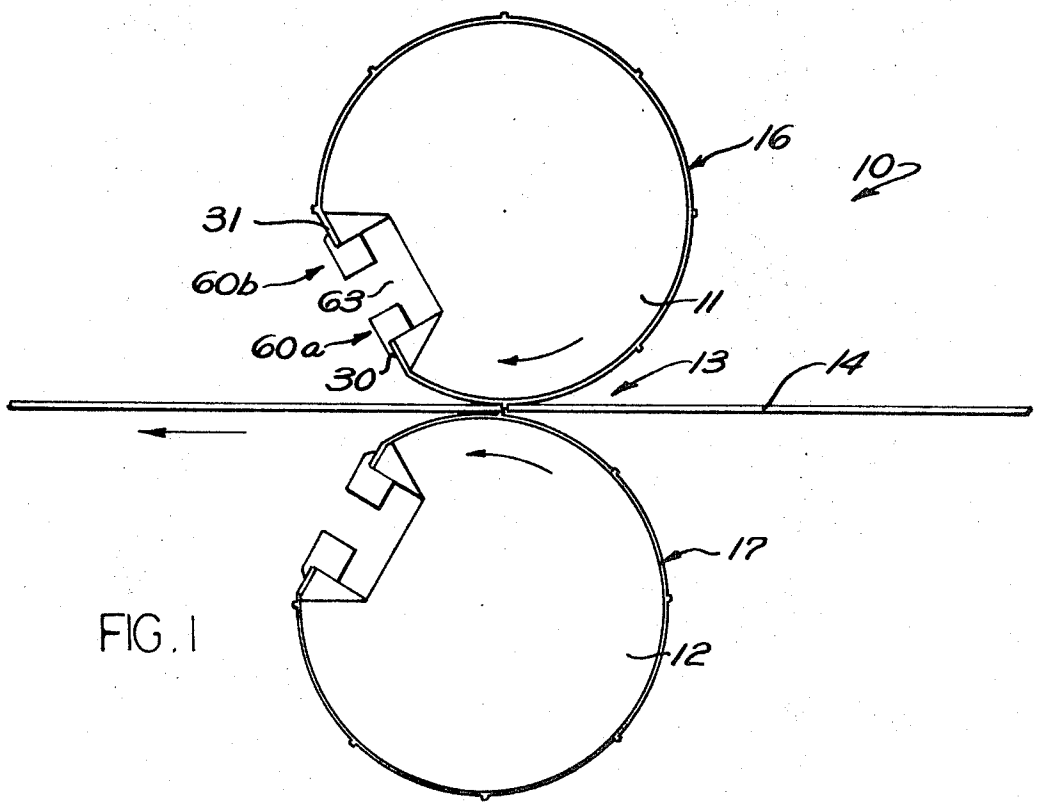


FIG. 1

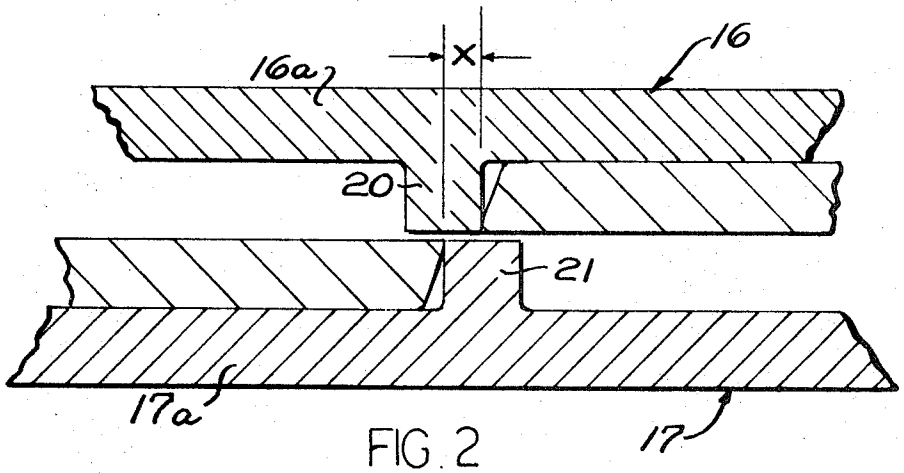


FIG. 2

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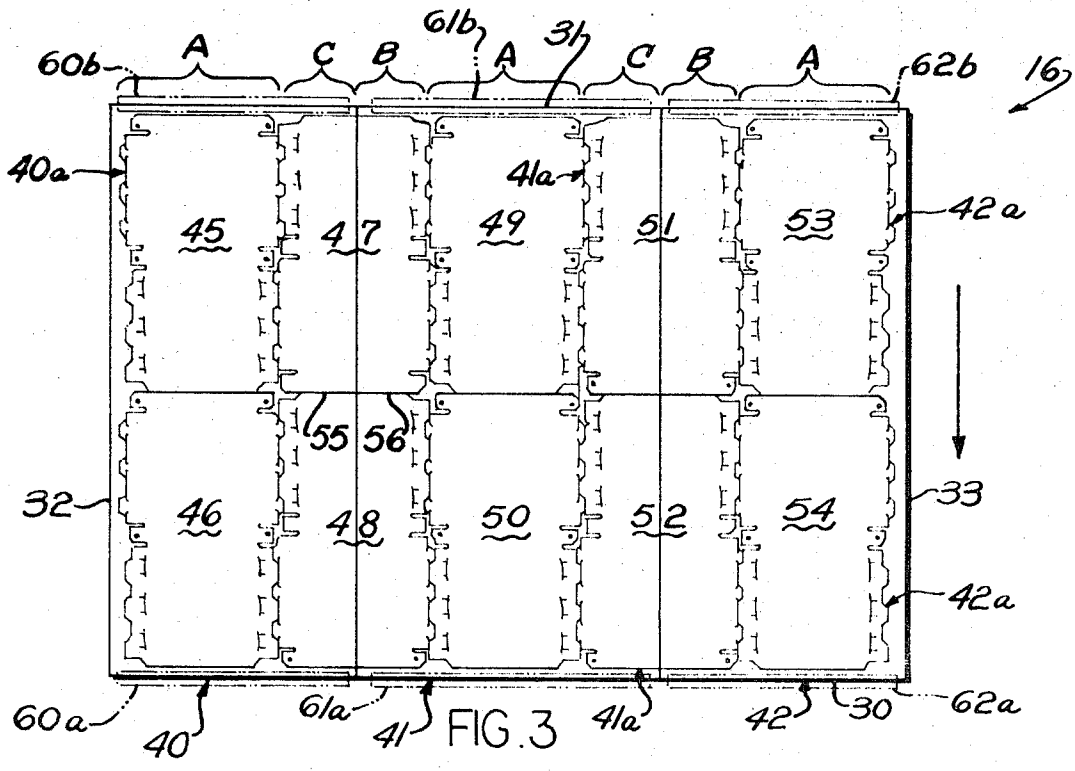


FIG. 3

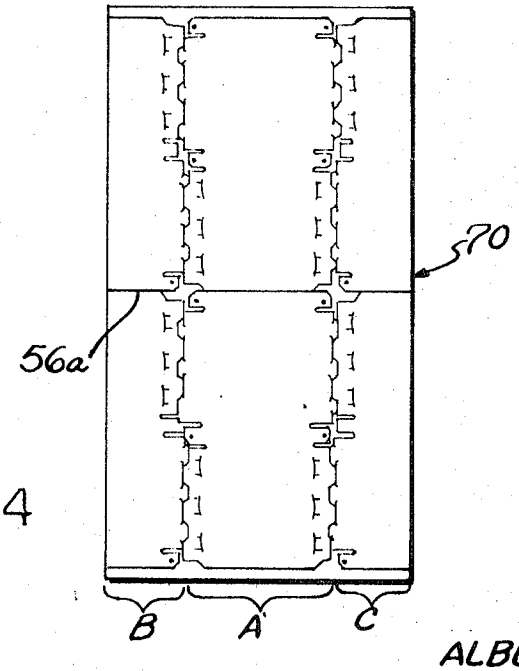


FIG. 4

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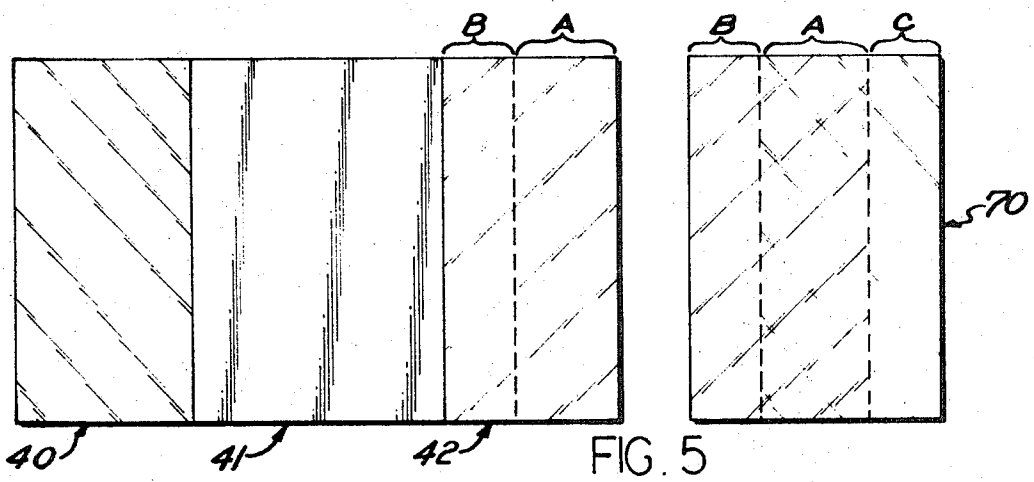


FIG. 5

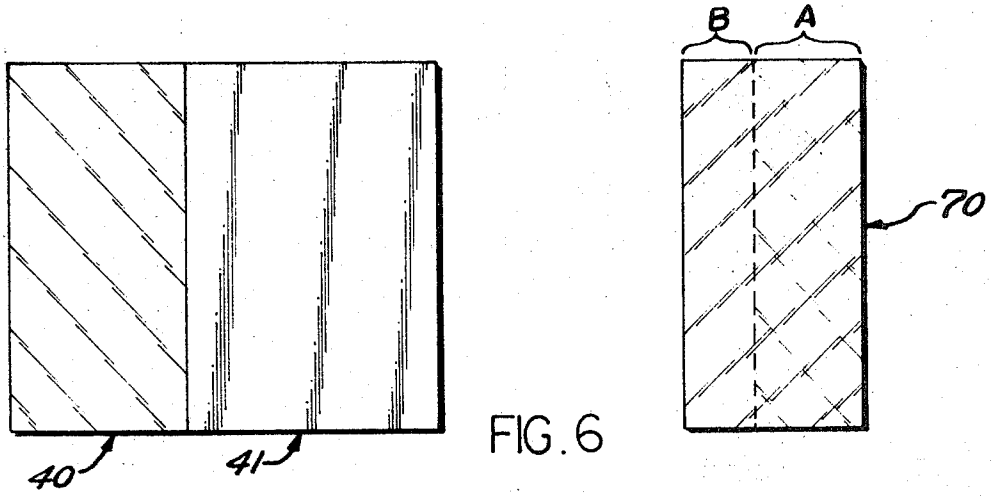


FIG. 6

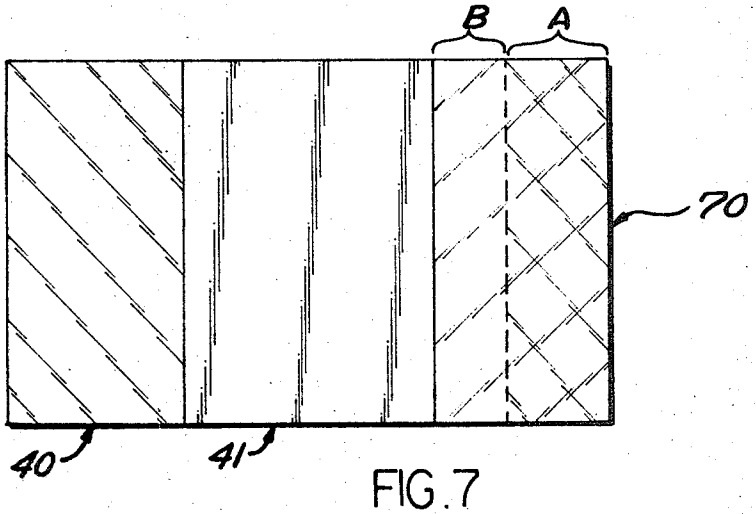


FIG. 7

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SEVERING APPARATUS

The present invention relates to an apparatus for severing material, and particularly relates to cooperable dies for use in severing material.

Recently developed dies which may be used for cutting and creasing sheet material are disclosed in Downie U.S. Pat. No. 3,142,233. The Downie patent discloses a pair of dies for cutting and creasing sheet material, and which dies have narrow lands which project above the main body of the die and form severing or creasing lands and which cooperate to effect severing or creasing of sheet material which is advanced between the dies. Other recently developed severing and creasing dies are disclosed in Sarka application Ser. No. 700,538. The dies disclosed in Ser. No. 700,538 also include projecting members which cooperate to effect the cutting and creasing of sheet material which is advanced between the dies.

In general, the dies disclosed in both the Downie patent and the Sarka application have projections which effect the severing of the material which is advanced between the dies. The projecting lands are formed on the dies in predetermined locations defining a layout of material locations which are to be severed. The layout primarily involves the arrangement of the projections so as to cut carton blanks, or a plurality of carton blanks from sheet material which is advanced between the dies.

In severing of the material, the dies are subjected to the possibility of damage. Such damage could result from material sticking to the dies or the fact that the die in a particular area has a large number of cutting lands or severing projections, which result in an excessive amount of loading in that particular area of the die. There are a variety of reasons why certain areas of the dies may wear and become damaged.

When one of the dies of a set of dies is damaged, this, of course, means that the die must be replaced in order to continue the cutting and creasing of the material. The replacement of the complete die is rather expensive. Moreover, the replacement of one die often necessitates the replacement of the cooperating die since cooperating dies are accurately made to work with each other.

Accordingly, the principal object of the present invention is the provision of an improvement in material-severing dies of the above noted type wherein a die which is damaged in a particular location may be repaired at a minimum cost and in a manner which does not involve the replacement of the entire die.

A further object of the present invention is the provision of a new and improved apparatus for severing materials in selected locations which includes cooperable material-severing dies and wherein at least one of the severing dies is formed of a plurality of separate discrete die sections which may be replaced in the event any one of them is damaged without replacing the other die sections.

A still further object of the present invention is the provision of a new and improved apparatus for severing material in selected locations and which includes cooperable material-severing dies with one of the dies being formed of a plurality of die sections having projections thereon which comprise the sheet-severing elements and wherein an additional die section is provided which is similar in construction to the die sections which comprise the one die so that the additional die section may be used to replace any one of the die sections of the one die.

Another object of the present invention is the provision of a new and improved apparatus for severing materials in selected locations and which includes first and second relatively movable die support members and wherein first and second material-severing dies are supported on the first and second die support members and at least one of the dies comprises a plurality of die sections having projections thereon and wherein means is provided for securing each of the die sections to the die-support member and is releasable to provide for selective removal of at least one of the die sections from the die-support member while the other die sections remain secured thereto, for purposes of replacement of the one die section, in case of damage thereof, by another similar die section.

Further objects and advantages of the present invention will be apparent to those skilled in the art to which is relates from the following detailed description of a preferred embodiment thereof, made with reference to the accompanying drawings, in which:

FIG. **1** is a schematic illustration of an apparatus for severing sheet material and embodying the present invention;

FIG. **2** is a fragmentary sectional view showing the operative relationship between cooperating severing dies used in the apparatus of FIG. **1**;

FIG. **3** is a plan view of a die used in the apparatus of FIG. **1** and formed of a plurality of die segments;

FIG. **4** is a view of an additional die segment which may be utilized for replacing any one of the die segments of the die of FIG. **3**; and

FIGS. **5**, **6** and **7** illustrate schematically the steps in the replacement of one of the die sections of FIG. **3** with the auxiliary die section of FIG. **4**, in the event of damage to one of the die sections of FIG. **3**.

The present invention provides an improved apparatus for severing material in selected locations and, in particular, provides improved material-severing dies which have narrow projections formed integrally with and extending from the main portion of the die for effecting severing of sheet material which is advanced between the dies. In particular, the construction of the dies may take many different forms and may be of the form disclosed in Downie U.S. Pat. No. 3,142,233, or may be of the form disclosed in Sarka application, Ser. No. 700,538, assigned to the assignee of the present invention. Moreover, dies of the present invention may be applied to a variety of types of severing apparatus and may be used in either rotary severing equipment, such as disclosed in Sarka U.S. Pat. No. 3,383,991 or in flat-bed or reciprocating severing equipment wherein one die is reciprocated toward and away from another die.

As representative of the preferred embodiment of the present invention, the present invention is illustrated in the drawings as applied to a rotary cutting and creasing apparatus **10** illustrated in FIG. **1**. The apparatus **10** includes a pair of die-support members, which in the illustrated embodiment comprises a pair of cylinders **11**, **12** which cooperate to define a cutting nip **13** therebetween. Sheet material **14** in the form of cardboard, or the like, is advanced through the nip **13** formed by the rollers **11**, **12** and is severed at selected locations as it is advanced through the nip.

The cylinder **11** carries a material forming or severing die **16**, and the cylinder **12** carries a die **17**. The dies **16**, **17** cooperate to effect the cutting and creasing of the sheet material **14** which is advanced between the dies. The sheet material **14**, of course, could be either in sheet form or in web form.

The dies **16**, **17** which are provided on the cylinders **11**, **12** and which cooperate to effect the cutting of the sheet material **14** which is advanced between the cylinders are herein disclosed as the type disclosed in the Downie U.S. Pat. No. 3,142,233. As illustrated in FIG. **2**, the die **16** has a plurality of severing projections **20** thereon, and the die **17** has a plurality of severing projections **21** thereon. These projections are formed on the dies integrally with the main body **16***a*, **17***a* of the dies **16**, **17** and project above the main bodies **16***a*, **17***a* of the dies **16**, **17**, respectively. The projections have flat land areas on the outer ends thereof which have a certain area of overlap, designated X in FIG. **2** when in the cutting nip **13**, and cooperate due to this area of overlap to effect the formation of a cut line in the sheet material. The dies **16**, **17**, as is known, also could be provided with a plurality of male and female creasing elements which would also be in the form of projections which extend from the main bodies **16***a*, **17***a* of the dies. As the material is advanced through the nip **13**, the dies **16**, **17** and specifically the projections **20**, **21** effect a cutting of the material in the area of the overlap designated X in FIG.

2, and creasing of the sheet material can be effected by creasing elements on the dies **16, 17** and which are not shown.

The projections **20, 21**, sever or cut the material **14** in selected locations. Specifically, the projections **20, 21** are located on the dies so as to define a layout of the selected material locations to be severed. A typical layout of the locations of severing elements or projections is illustrated schematically by the way of example in FIG. **3**. The various full lines illustrate the location of the projections **20** on the die **16**. Corresponding projection **21** would be formed on the die **17**. It should be apparent from viewing FIG. **3** that the die **16** will cut **10** carton blanks, the areas of which are designated **45—54** in FIG. **3**, from a single sheet of material **14** which is advanced through the cutting nip **13**. The carton blanks are arranged five to a row, with two rows being formed from each rotation of the cylinders **11, 12**. The layout shown is a layout in which the carton blanks are identical. The layout could be a mixed layout where the carton blanks differ.

The layout of the die **16**, which is illustrated in FIG. **3**, is such that when curved to form the die for the cylinders **11, 12**, the die **16** would rotate in a direction indicated by the arrow in FIG. **3**, and that would be the same direction that the sheet material **14** is advanced through the cutting nip. It should be apparent therefore that the leading edge of the die will be the edge **30**, while the trailing edge of the die will be the edge **31**. The side edges of the die are designated **32, 33**.

In accordance with the present invention, at least one of the dies **16, 17** or both are made of a plurality of separate discrete sections. As disclosed herein, the die **16** is made up of a plurality of sections, generally designated **40, 41** and **42**. Each of the die sections **40—42** is adapted to extend circumferentially around the cylinder **11** and when the die sections are placed in abutting side-by-side relationship, as illustrated in FIG. **3**, the die sections form the complete die **16**.

The die sections **40, 41, 42** each have a pattern or layout of sheet-severing elements **20** thereon, indicated by full lines in FIG. **3**, and are designated **40*a***, **41*a***, and **42*a***, respectively. Moreover, the die sections **40—42** are similar in construction and have corresponding portions with similar positioning of the severing projections **20** thereon. As best illustrated in FIG. **3**, the die section **40** has a portion which is designated A in FIG. **3** and a portion which is designated C. The portion A is the portion which effects cutting around areas **45, 46**. The portion C effects cutting around half the areas **47, 48**.

The die section **41** includes, what may be termed, three portions, designated A, B and C. The portion A cuts around the complete areas **49, 50**, while the portion B cuts around the other half of the areas **47, 48**. The portion A, of course, is identical to the portion A of the section **40**. The portion C of section **41** is identical to the portion C of the section **40** and cuts around half of the areas **51, 52**.

The die section **42** has portions which are designated A, B. The portion A cuts around the areas **53, 54** and is identical to the portions, designated A of the die section **40, 41**. The portion B cuts around the other half of the areas **51, 52**. The portion B is identical to the portion B of the die section **41**. It should be apparent, of course, that with the die sections **40, 41, 42** positioned as shown in FIG. **3** with their side edges in abutting relationship, the complete die **16** is formed.

In view of the fact that the die sections **40, 41, 42** are separate discrete sections, these sections are preferably mounted independently by separate means on the cylinder **11** so that the sections can be separately mounted on the cylinder and separately removed from the cylinder **11**. To this end, the cylinder **11** is provided with a plurality of leading and trailing edge clamps, indicated schematically in FIG. **3**. The leading edge clamps, are located axially along the cylinder **11** and are designated **60*a***, **61*a***, **62*a***, and the trailing edge clamps are also located axially along the cylinder **11** and are designated **60*b***, **61*b***, **62*b***. The leading and trailing edge plate clamps are positioned in an axial gap **63** located in the cylinder **11**, as is conventional.

The clamps **60*a***, **60*b*** secure the die section **40** on the cylinder **11**, and are releasable to permit the removal of the die section **40** from the cylinder **11** without removal of the die sections **41, 42**. The clamps **61*a***, **61*b*** secure the die section **41** to the cylinder **11**, and the clamps **62*a***, **62*b*** secure the die section **42** to the cylinder **11**. The clamps **61*a***, **61*b*** and **62*a***, **62*b*** respectively, are releasable so that the die sections **41, 42** may be separately removed without removal of the other die sections. The clamps may be of any suitable construction, and reference may be made to U.S. Pat. No. 2,965,025 for a suitable clamping mechanism which may be utilized for separately clamping the die sections on the cylinder **11**. In view of the fact that the details of the clamping mechanism which is utilized for holding the die sections **40—42** on the cylinder **11** do not form a part of the present invention, the clamps will not be described herein in detail.

In view of the similarity of the die sections **40, 41, 42**, namely, that section **40** which includes portions A, C is identical with portions A, C of section **41** and that the die section **42** having the portions B, A is identical to the portions B, A of the section **41**, the manufacture of the sections is simplified. Of course, these die sections are made in the manner described in the Downie patent referred to hereinabove. Specifically, the sections are made by etching process and the areas which are to form the projections both for severing and creasing are provided with a resist-hardened material through a photographic process. The other areas are then etched with a suitable etchant in order to etch away the main body of the die. As a result, the projections are formed on the die sections. In view of the fact that the sections are similar, the same negatives or similar negatives may be utilized in the photoetching process for manufacturing the die sections.

When the die plate **16** is mounted on the cylinder **11** and utilized for the severing of sheet material, the separate sections **40–42** of the die effect the severing of the material advanced through the nip **13** defined by the cylinders **11, 12**. Certain severing projections, such as those designated **55, 56** on the die sections **40, 41** are aligned in an abutting relationship so that the adjacent ends of the projections **55, 56** are aligned. The fact that there may be a slight space, between the aligned ends of the projections **55, 56** does not affect the cutting of the material and the cutting is effected readily and without detrimental effects.

As the dies **16, 17** operate, there are many problems which could result in damage to one of the die sections **40—42** necessitating replacement of the particular die section. Of course, if the entire die is made as a one-piece unit, such as disclosed in the Downie patent or in the Sarka application referred to hereinabove, the entire die would have to be replaced at substantial cost. In accordance with the present invention an auxiliary or additional die section, designated **70**, is provided and shown in FIG. **4**, and may be utilized to replace any one of the sections **40, 41, 42** of the die **16** in the event that any one of these sections is damaged.

The additional or auxiliary die section **70**, which is illustrated in FIG. **4**, is identical to the die section **41**, and similar reference numerals will be applied thereto to designate corresponding portions thereof. The additional die section **70** includes areas A, B, and C which are identical to the corresponding areas of section **41**. It should be apparent, of course, that if the die section **41** becomes damaged all that is necessary to effect a replacement of the die section **41** with the die section **70** is to release the clamps **61*a***, **61*b*** and remove the damaged die section **41** from the cylinder. The additional die section **70** can then be placed on the cylinder **11** and clamps **61*a***, **61*b*** operated to secure the die section **70** thereon. Of course, during the replacement the die sections **40, 42** are not removed from the cylinder **11** and remain in their respective positions.

In the event that the die section **40** would become damaged the additional die section **70** could also be used to replace the die section **40**. In so doing, the area B of the die section **70** would have to be removed from the die section **70** by cutting

along a line adjacent the area A and by suitably grinding down the undesired severing elements which would be projecting therefrom. With the area B removed and certain of the severing lands ground down, the additional section **70** would be identical to the section **40** and, therefore, could be used in place thereof. The section **70** could also be used for replacing the die section **42** in much the same manner as discussed above in connection with the section **70** replacing the die section **40**. It would merely be necessary for the die section to replace the die section **42** to remove the area C of the die section **70**, grind down the severing lands thereon which are unnecessary, and then to place the section **70** in position for the section **42**. In this manner, the completed die would again be formed. In view of the above, it should be clear that the additional die section **70** can be used to replace any one of the die sections **40, 41, 42**, and therefore, if any one of the sections is damaged the entire die need not be discarded and replaced at substantial cost.

It should be clear that certain of the cutting projections such as **56** on the die section **41**, have a corresponding cutting projection on the die section **70**, such as designated **56***a*. When the die section **70** is replaced for die section **41**, the projection **56***a*, of course, must align with the projection **55** in order to provide a continuous cut line in the material. By having the adjacent ends of the projection **55**, **56***a* aligned, they operate to provide a continuous cut line in the material. In this connection, as noted above, if there is some slight spacing between the aligned end of the cutting land **55** and the aligned end of the cutting land **56***a* on the additional die section **70**, such spacing does not affect the severing action of these projections and a continuous cut line is still formed therein as long as the spacing between the aligned ends of the projections **55**, **56***a* is not excessive.

FIGS. **5—7** illustrate schematically, the die sections **40, 41, 42** and the additional die section **70** and the steps which are performed in the replacement of one of the die sections, namely die section **42**, by the die section **70**. As illustrated in FIG. **5**, the die **11** is completely formed by the die sections **40, 41, 42**. The die section **70** is illustrated as being a replacement die section and may be stored in any suitable location for use in the event of damage to any one of the die sections **40, 41, 42**.

For purposes of illustration, consider the die section **42** as having been damaged. The die section **42** is removed from the die-supporting member in the machine in which it is being used. In the preferred embodiment, the clamps **62***a*, **62***b* are released and the die section **42** is removed from cylinder **11**. When the die section **42** is removed from cylinder **11**, the die sections **40, 41** remain on the machine in their proper working location. In view of the fact that the section **42** is not exactly identical to the section **70**, the section **70** must be modified in order to be made identical to the section **42**. In this case, the area C of the section **70** must be removed from the section **70** in order to provide a die section which has the areas B, A and is identical to the die section **42**. This, of course, is done by cutting the portion C of the die section **70** away from the sections B, A and then griding down those areas which remain which are unwanted or undesired severing or creasing lands. Once the portion of the section **70** is removed, the section **70**, as indicated in FIG. **6**, is identical to the section **42** prior to its being damaged. The section **70** may be placed on the die-supporting member in proper relationship with the sections **40, 41** in order to again provide a complete die having the desired layout of severing lands. The section **70** of course, as noted hereinabove, includes severing lands which must have their ends aligned with ends of the severing lands on the die section **41** so as to provide a continuous cut line in much the same manner as discussed hereinabove with respect to the severing lands **55, 56**.

It should be apparent from the above that applicant has provided a new and improved apparatus for severing sheet material and that certain modifications, changes, and adaptations may be made therein and it is intended to cover all such changes, modifications, and adaptations which come within the scope of the appended claims.

I claim:

1. A die for severing sheet material into blanks comprising a plurality of plate members placed in side-by-side relationship to form said die, said die having opposed first sides and opposed second sides generally perpendicular to said opposed first sides and said plate members having first opposed sides providing said first sides of said die and abutting sides generally perpendicular to said first sides and portions extending along said first opposed sides of said plate members to be gripped to secure the plate members during a severing operation, adjacent ones of said plate members each having projection means thereon of substantially uniform height formed integrally with the plate member so as to be one piece therewith and adapted to sever said sheet material, said projection means on adjacent plate members comprising projection means extending transversely to the abutting sides of said plate members to form a continuation of the projection means on the adjacent plate member for severing sheet material to form a side of the blank which lies along a line generally transverse to the abutting side.

2. A die as defined in claim **1** wherein said plate members are flexible plate members and said projection means are formed by recesses in said plate members.

3. A die as defined in claim **1** wherein one of said plate members has projection means located along a line extending generally transversely of said first sides of said plate member for severing the entire extent of one side of a blank.

4. Apparatus for severing material in selected locations comprising first and second cooperable material severing dies, each of said first and second dies having sheet-severing elements in the form of narrow projections extending above the surface of the main body thereof, said sheet-severing elements being disposed on the respective dies to define a layout of the selected material locations to be severed, at least one of said dies comprising at least three separate discrete die sections, each of said die sections having projections thereon comprising the sheet-severing elements thereon, at least one projection on one die section having one end thereof aligned with an adjacent end of another projection on another die section, said projections having the aligned ends cooperating with at least one projection on the other of said dies to form a continuous cut line in the material, said apparatus further comprising an additional die section having projections corresponding in position to the projections on all of said die sections, two die sections of said three die sections being different from each other and said third die section having projections corresponding to all of the projections on said two die sections, said additional die section corresponding with said third one of said die sections so as to be replaceable for the third one of said die sections or for either of the said two die sections upon the removal of selected portions thereof in the event of damage to one of said two die sections.

5. A die as defined in claim **3** wherein said plate members are flexible and said projection means are formed by recesses in said plate member.

6. Apparatus for severing sheet material to form generally rectangular blanks having opposed first sides and opposed second sides extending generally perpendicularly to each other, said apparatus comprising a die-holding member, a die to be mounted onto said die-holding member, said die having portions along opposed first sides to be clamped to connect said die to the die-holding member during the severing operation, said die comprising a plurality of plate members having opposed first sides forming said first sides of said die and opposed second sides generally perpendicular to said first sides with adjacent plate members having ones of said second sides in abutting relationship with each other, die-holding means on said die-holding member for gripping said plate members, said plate members each having first projection means thereon integrally formed as one piece with the body of the plate member and located intermediate said second sides of the

plate member and extending generally parallel thereto for severing along one of said second sides of a blank being severed with the projection means for severing the other opposed second side being on a different plate member and second projection means located at opposite ends of said first projection means and extending from said first projection means to at least one of said second sides of said plate member, said second projection means on adjacent die sections being aligned at their ends whereby said first opposed sides of said blank are formed by second projection means on different die sections.

7. Apparatus for severing sheet material as defined in claim 6 in which said die-holding member is a cylinder and said plate members are flexible plates.

8. Apparatus for severing material in selected locations comprising first and second relatively movable die-support members, first and second cooperable material-severing dies on said first and second die-support members, respectively, each of said first and second dies having sheet-severing elements in the form of narrow projections extending above the surface of the main body thereof, said sheet-severing elements being disposed on the respective dies to define a layout of the selected material locations to be severed, at least one of said dies comprising a plurality of separate discrete die sections, means for securing each of said die sections to one of said die support members and releasable to provide for selective removal of at least one of said die sections from said die-support member while the other die sections remain secured thereto, each of said die sections having projections thereon comprising the sheet-severing elements thereon, at least one projection on one of said die sections having one end thereof aligned with an adjacent end of another projection on another of said die sections when secured to said one die-support member, and said projections having the aligned ends cooperating with at least one projection on the other of said dies to form a continuous cut line in the material, an additional die section having projections thereon corresponding in position to the projections on all of the die sections and being replaceable for any one of said plurality of die sections upon the removal of selected severing elements therefrom.

9. Apparatus for severing material in selected locations comprising first and second relatively movable die-support members, first and second cooperable material-severing dies on said first and second die-support members, respectively, each of said first and second dies having sheet-severing elements in the form of narrow projections extending above the surface of the main body thereof, said sheet-severing elements being disposed on the respective dies to define a layout of the selected material locations to be severed, at least one of said dies comprising a plurality of separate discrete die sections, means for securing each of said die sections to one of said die-support members and releasable to provide for selective removal of at least one of said die sections from said die-support member while the other die sections remain secured thereto, each of said die sections having projections thereon comprising the sheet-severing elements thereon, at least one projection on one die section having one end thereof aligned with an adjacent end of another projection on another die section when secured to said one die-support member, and said projections having the aligned ends cooperating with at least one projection on the other die to form a continuous cut line in the material, said first and second die support members being cylinders which define a severing nip and said means for securing each of said die sections to said die-support members comprising axially spaced clamps for securing the leading and trailing edges of the die sections independently to said cylinder for rotation therewith.

10. Apparatus for severing sheet material as defined in claim 7 wherein said means for gripping said plate members are disposed in a gap extending axially of said cylinder.

11. Die means for forming blanks comprising a die section for severing sheet material for forming a portion of a blank which is to be severed from the sheet material, the blank having first opposed sides and second opposed sides extending along lines generally perpendicular to said first opposed sides, said first and second opposed sides forming the outer periphery of the blank, said die section forming the outline of part of said blank for the full extent of the blank along one of said second opposed sides and comprising a plate member having first opposed sides and second opposed sides generally perpendicular to each other and defining the outer periphery of the plate member, said plate member having severing projections integrally formed with the body thereof so as to constitute a one-piece element for severing said sheet material along sides of said blank comprising first projection means located along a line intermediate said second opposed sides of the plate member and generally parallel thereto for severing along one of said second opposed sides of said blank for its full extent and second projection means located at the opposite ends of said first projection means for severing along said first opposed sides of said blank, said second projection means extending to one of said second opposed sides of said plate member to cooperate with projection means on an adjacent die section for severing the remainder of said first opposed sides of said blank, said die section having portions along its said first opposed sides to be clamped to secure the die during a severing operation.

12. A die section as defined in claim 11 wherein said plate member is of a substantially uniform thickness and said projection means is formed by recesses in said die member.

13. Die means as defined in claim 11 wherein said die means comprises a second die section having projection means thereon for forming the other of said second opposed sides of said blank and the remainder of said first opposed sides.