May 24, 1966 H. HARDY 3,252,365

CUTTING MACHINE WITH AUXILIARY DIE

Filed Oct. 23, 1964 2 Sheets-Sheet 1

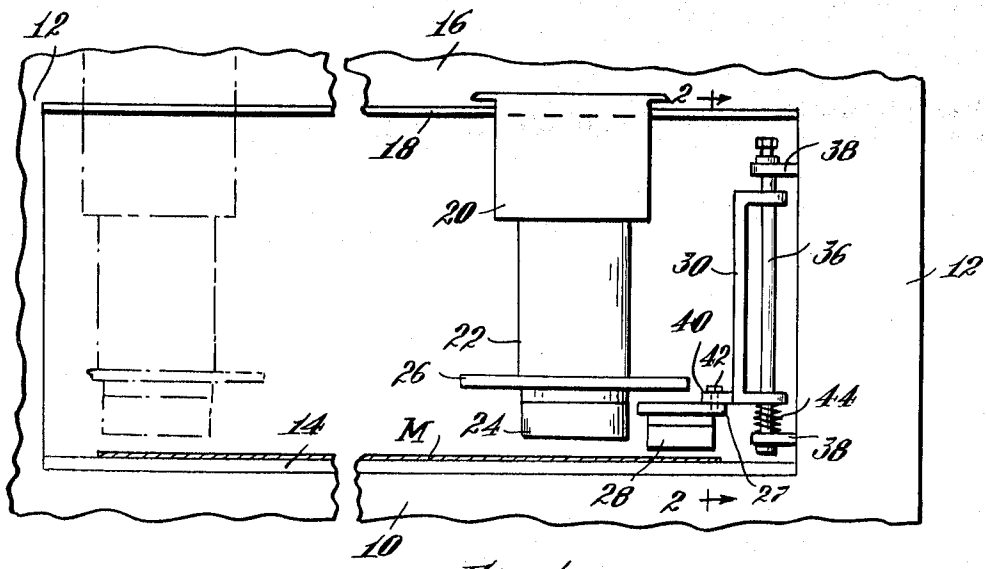


Fig. 1

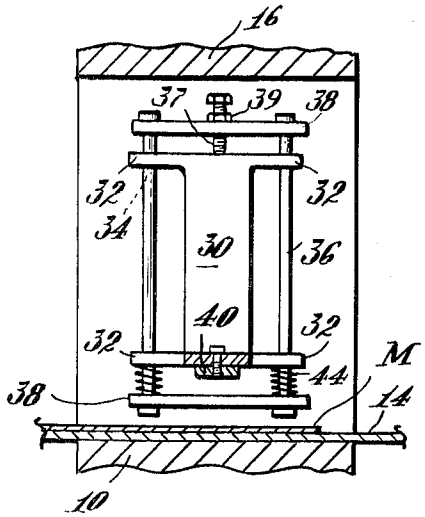


Fig. 2

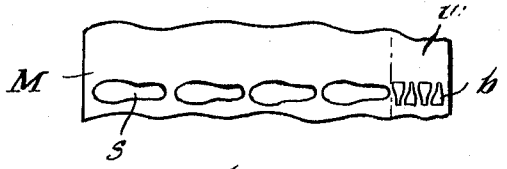


Fig. 3

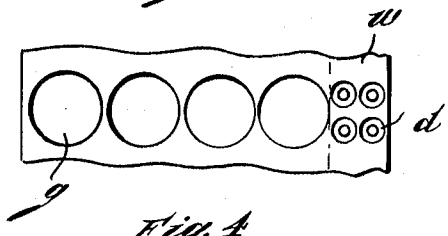


Fig. 4

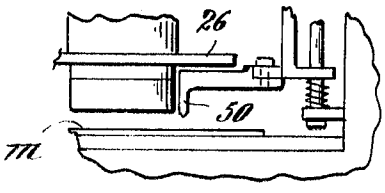


Fig. 9

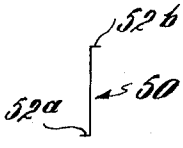


Fig. 10

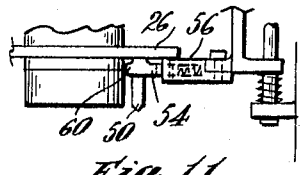


Fig. 11

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CUTTING MACHINE WITH AUXILIARY DIE

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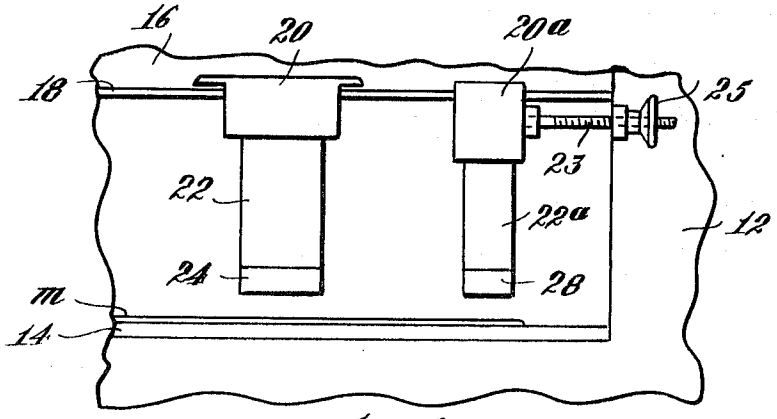


Fig. 5

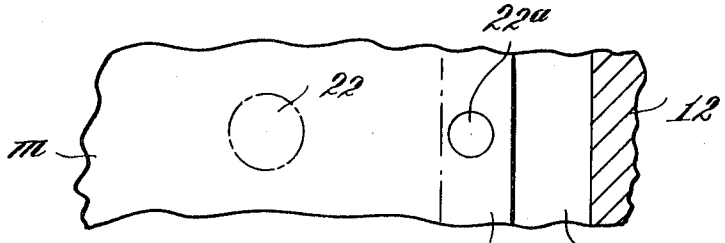


Fig. 6

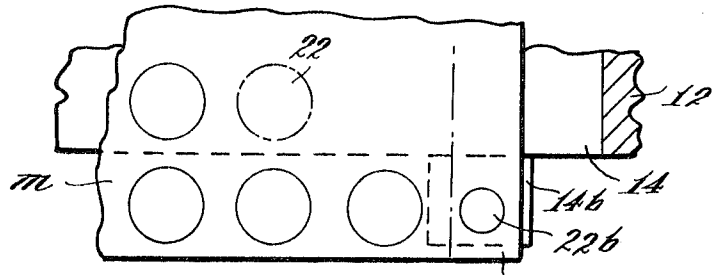


Fig. 7

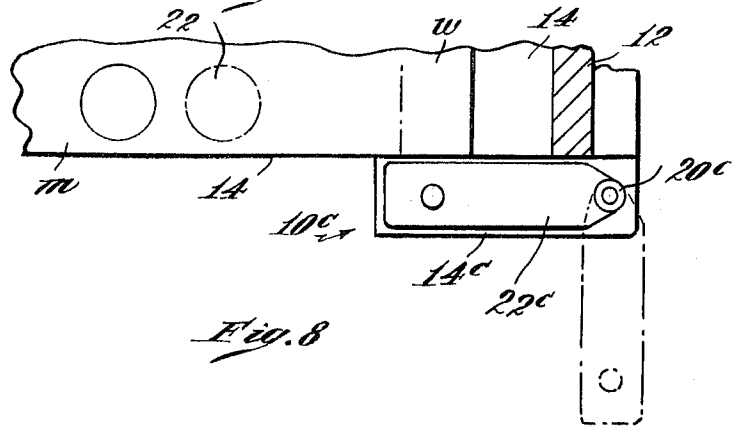


Fig. 8

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3,252,365

CUTTING MACHINE WITH AUXILIARY DIE

Henry Hardy, Cambridge, Mass., assignor to Compo Shoe Machinery Corporation, Waltham, Mass., a corporation of Delaware

Filed Oct. 23, 1964, Ser. No. 405,997
25 Claims. (Cl. 83—34)

This invention relates to die-cutting machines of the kind disclosed in the pending application of Evold O. Peterson, et al., Serial No. 383,378, filed July 17, 1964, wherein a die is supported above a platen for movement transversely of and perpendicular to the platen to enable cutting, from sheet or web material resting thereon, a number of pieces across the sheet, and wherein the sheet is advanced lengthwise of the platen to enable cutting from the sheet successive rows of pieces.

It is not always possible to obtain sheet material in widths such that a whole number of pieces of a predetermined size can be cut therefrom without having some of the material left over at one side and this invention has for its principal objects to provide for utilizing the material left over at the far side when the material is wider than a whole number of pieces of predetermined size, without interfering with the normal operation of the machine, by cutting from the material left over at the far side useful pieces of different size; to provide means which is adapted to be used in conjunction with the machine when it appears that there will be left-over material at the far side in spite of planning of the primary cutting operation to make use of the left-over material; to provide means which may be actuated automatically with or independently of the normal cutting operation of the machine; to provide means which is of simple construction and will enable employing dies of different size; and to provide means which will support one or more auxiliary dies depending upon the area of the left-over material and the size and possible disposition of the pieces to be cut therefrom.

In the aforesaid machine, there is a head which moves a primary cutting die transversely of a work-supporting bed in predetermined steps, and a ram carried by the head operative, during the interval between transverse movements, to move the die into cutting engagement with sheet material resting on the bed. In accordance with this invention, auxiliary means is provided adjacent the far side of the bed for supporting one or more auxiliary cutting dies for movement from a position above the bed into cutting engagement with the excess or left-over sheet material at that side of the bed. In one form of the invention, the means supporting the auxiliary dies is mounted on the machine frame and movement thereof is effected when the head supporting the primary cutting die reaches the last full cutting position, for example, by a part on the ram movable therewith as the latter moves downwardly to make the cutting stroke. In this form of the invention, the auxiliary means is yieldably supported above the bed so that following depression of the die into cutting engagement with the bed it will be re-elevated to its initial position. Alternately, the auxiliary cutting die may be supported by a head and ram independently of the head and ram which support the primary cutting die. The head and ram for the auxiliary cutting die is preferably adjustable transversely of the bed to position the ram directly above the excess material and may be operated automatically during the last cutting operation of the ram supporting the primary cutting die or independently thereof. The ram supporting the auxiliary cutting die may be in alignment with the ram supporting the primary die or mounted forwardly thereof in the direction of movement of the material, in which event it will have a bed of its own mounted on a level with the bed of the primary

cutting die. To make possible the advantages of using the excess material without removing it from the machine and without material modification of the primary die-cutting machine, a clicking machine may be placed adjacent the side of the machine where the waste occurs with its bed adjacent that of the die-cutting machine so that as the sheet is advanced beyond the forward side of the bed of the primary die-cutting machine it will cross the bed of the clicking machine. This enables an operator to cut pieces from the waste or not as he pleases. If desired, the excess material may be separated from the sheet by a cutter operable, in conjunction with the last die-cutting operation, to cut the sheet lengthwise.

The invention will now be described in greater detail with reference to the accompanying drawings wherein:

FIG. 1 is a front elevation of a die-cutting machine of the kind of which the invention is employed, showing the novel die-cutting means in elevation;

FIG. 2 is an elevation taken on line 2—2 of FIG. 1 at the right side of the machine as shown in FIG. 1;

FIG. 3 is a fragmentary plan view of a sheet of material illustrating the arrangement of a plurality of shoe parts of predetermined size distributed transversely of the sheet but leaving a narrow area at the right side of insufficient width to cut a large piece and showing smaller pieces cut from the leftover material at that side;

FIG. 4 is a corresponding plan view wherein as many circular pieces of a given diameter are cut transversely of the sheet as possible and the remaining area is used for cutting smaller circular pieces;

FIG. 5 is a fragmentary elevation of the die-cutting machine provided with a ram for supporting the primary cutting die and a ram for supporting the auxiliary cutting die;

FIG. 6 is a plan view of the bed of the die-cutting machine shown in FIG. 5, showing the positions of the rams diagrammatically aligned transversely of the bed;

FIG. 7 is a plan view of an alternative apparatus in which an auxiliary bed is mounted at the forward side of the bed of the die-cutting machine in the direction of feed, showing the primary ram and auxiliary ram diagrammatically located over their respective beds;

FIG. 8 is an elevation of a die-cutting machine with a clicker positioned at the side where the excess material occurs adjacent the forward side of the bed;

FIG. 9 is an elevation of a cutter for dividing the sheet lengthwise to separate the excess material at the far side from the sheet to enable easier manipulation of the separated material;

FIG. 10 is a plan view of the cutting edge of the cutter shown in FIG. 9; and

FIG. 11 is an elevation of the cutter such as shown in FIG. 9 mounted for yielding in a horizontal plane.

Referring to the drawings (FIG. 1), the machine as disclosed in the aforesaid application has a base part **10** from the opposite ends of which rise spaced columns **12**. A bed **14** is supported on the base between the columns in a horizontal position upon which work may be positioned and advanced in suitable lengths for cutting. A beam **16** is mounted transversely of the bed **14** and parallel thereto between the upper ends of the columns **12** and has on its underside spaced parallel tracks **18**, only that at the front side of the beam being shown, on which is slidably mounted a head **20**. The head is thus movable lengthwise of the beam and transversely of the bed. A ram **22** is supported by the head **20** for movement therewith and is movable relative to the head, perpendicular to the bed **14**, to apply cutting pressure to a cutting die **24** mounted at its lower end. The cutting die is removably fastened to a plate **26** secured to the lower end of the ram.

As disclosed in the aforesaid application, the head

is moved from left to right and from right to left in a series of steps of equal length to cut as many pieces of corresponding size from the work *m* resting on the bed as is possible. Very often, in spite of carefully selecting the width of material for use in cutting pieces of a predetermined size therefrom and of positioning the cuts transversely to obtain a maximum number widthwise of the work, a margin will be left at the right-hand side of the sheet, as indicated at *w* in FIGS. 3 and 4, which is not wide enough for another piece and would ordinarily be discarded as left-over, or, if not, might be removed from the machine and reused in some other machine for die-cutting of different size pieces. The principal purpose of this invention is to make use of this left-over material without having to remove it from the machine and as a part of the operation so that neither time nor material is lost. Thus, for example, as shown in FIG. 3, after cutting a plurality of sole blanks *s*, backstays *b* are cut from the left-over material at the margin *w*. In FIG. 4, after cutting a plurality of large circular gaskets *g* crosswise of the work, the left-over material at the margin *w* is used to obtain a plurality of smaller washers *d*.

The cutting of the pieces from the left-over area at the right-hand side of the sheet material may be accomplished as a part of the last cutting operation in which a full size piece is cut from the sheet material by means of an auxiliary die **28** yieldingly supported on the inner side of the column **12** at the right-hand side of the machine. Yielding support is provided for by a carrier **30** which has at its upper and lower end transversely spaced arms **32** (FIG. 2) containing vertically aligned holes **34**, by means of which it is mounted on spaced parallel, vertically disposed rods **36** for movement vertically relative to the surface of the bed **14**. The rods **36** are supported at their upper and lower ends by bracket members **38** secured to the inner side of the column **12**. The lower end of the carrier has an inwardly projecting flange **40** to which an auxiliary die support **27** is removably fastened by one or more screw bolts **42**, so that dies of different shape may be mounted thereon to make the best use of the left-over material. The carrier **30** rests at its lower end on springs **44** surrounding the rods **36** between the arms **32** and the bracket **38** and support the carrier so that the die **28** is situated above the platen. A screw **37** threaded through the upper bracket member **38** against the upper end of the carrier **30** provides for adjusting the elevation of the die support **27** so that the latter will be below the horizontally extending portion of the plate **26** at the lower end of the ram. A lock nut **39** on the screw **37** provides for fixing it in its adjusted position. The carrier thus may be depressed to press the die **28** into engagement with work on the bed and, when released, the springs **44** will re-elevate it to its initial position. The plate **26**, which is secured to the lower end of the ram **22**, has an extension **46** at its right side which is operative, by engagement with the upper side of the auxiliary die support **27** when the head is at its extreme right-hand cutting position, to engage the support near the lower end of its cutting movement so as to move the die **28** into engagement with the bed substantially at the same time that the die **24** is moved into engagement with the bed. Optionally, yieldable means such as one or more compression springs may be socketed into the upper side of the plate **27** so as to provide for yieldable engagement of the plate **26** with the plate **27** to allow the primary die **24** to be brought into cutting engagement with the bed even though the auxiliary die **28** engages the bed first. In all other positions of the head, the extension **46** will not engage the die support **27** as it descends to its cutting position so that the only time that the die **28** is actuated is at the extreme right-hand cut. At all other times the die **28** will be held inoperative and out of the way above the bed.

If desired, as shown in FIG. 5, an auxiliary head **20***a* and ram **22***a* may be mounted on the tracks **18** at the underside of the beam **16** in line with the head **20** and ram **22**, in a position above the bed **14** at the side of the machine where the waste occurs, as shown in FIG. 6. The head is preferably adjustably transversely of the bed to enable centering it above the waste material and the ram may be actuated automatically, simultaneously with the operation of the ram **22** by suitable means, or its movement may be initiated manually by the operator. A screw **23** connected to the auxiliary head and a nut **25** mounted on the column **12** provides for adjusting the head relative to the bed.

Instead of mounting the auxiliary head and ram on the beam **16**, an auxiliary bed **14***b* may be secured to the forward side of the bed **14**, as shown in FIG. 7, and an auxiliary ram **22***b* supported above it for movement perpendicular thereto. In this form of the invention, the bed **14***b* is perferably supported at the level of the bed **14** and the ram **22***b* is operative automatically following the last cutting stroke of the ram **22**, or independently thereof to enable using or not using the waste material as desired.

The advantages achived by making it possible to cut pieces from the waste material without removing it from the machine, as shown in the foregoing figures, may also be obtained as shown in FIG. 8 by placing an auxiliary die-cutting machine, for example a clicking machine **10***c*, at the side of the die-cutting machine **10** where the waste occurs and at the forward side with its bed **14***c* adjacent the bed **14** of the die-cutting machine. The bed **14***a* may be at the same level as the bed **14** or below it as long at it is possible to advance the sheet material from the bed **14** across the bed **14***a*. As is conventional with clicking machines, an arm **22***c* is supported by a post **20***c* by means of which the arm may be swung parallel to the surface of the bed **14***c*, and when disposed above work resting on the bed lowered into engagement with cutting dies placed on the sheet material resting on th bed to effect cutting from the sheet material pieces corresponding to the shape of the die. The use of a clicking machine in conjunction with the die-cutting machine has the advantage that it can be moved out of the way when not required.

When the auxiliary die-cutting means is operated in conjunction with the primary die-cutting means, as illustrated in FIGS. 1, 2, 5 and 6, wherein a common bed is employed, the entire sheet, after cutting, is advanced uniformly across the forward edge of the bed where it is either allowed to pile up and removed when the die-cutting operation is completed, or is rolled up on a beam for such removal. When the auxiliary die-cutting means for the excess material is operated independently of the primary die-cutting means, as shown in FIGS. 7 and 8, it is desirable to separate the excess sheet material so that it can move forward beyond the forward edge of the bed of the primary die-cutting means onto the bed of the secondary cutting means without having to provide means for supporting the entire width of the sheet. This is achieved herein by yieldably mounting a cutter **50** (FIG. 9) on the column **12** in the manner in which the auxiliary die **28** is mounted on the column **12** in FIGS. 1 and 2, so that as the primary die **24** descends into cutting engagement with the sheet material, the part **26** will depress the cutter into engagement with the sheet to cut the sheet lengthwise. The cutting edge of the cutter **50**, as shown in FIG. 10, is preferably provided with oppositely extending portions **52***a* and **52***b* to insure a continuous cut lengthwise of the sheet for separating the excess therefrom.

In order to automatically compensate for variations in the travel of the primary die transversely of the bed, the cutter **50** is mounted, as shown in FIG. 11, by means of telescoping parts **54** and **56** normally held distended by a spring **58**, the part **56** being mounted on the bracket

30 as shown in FIGS. 1 and 9. A nub 60 on the inner end of the cutter support provides for maintaining the proper spacing between the cutter and the die.

It is possible, of course, to substitute any suitable die or number of dies for using up the left-over material available, and while the supporting apparatus is shown at the right-hand side of the machine, it would be used equally satisfactory at the left-hand side of the machine or both sides.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first cutting die, means operable to move the first cutting die transversely of the bed in a series of steps of predetermined amount commencing at one side of the sheet, said means being operable to move the die into cutting engagement with the sheet material during the intervals between steps, to cut from the sheet as many pieces of full size as possible; and means situated at the side of the machine where the excess material occurs for cutting additional pieces from the sheet material without removing the latter from the machine.

2. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first cutting die, means operable to move the first cutting die transversely of the bed in a series of steps of predetermined amount commencing at one side of the sheet, said means being operable to move the die into cutting engagement with the sheet material during the intervals between steps, to cut from the sheet as many pieces of full size as possible; and second means adjacent the side of the machine where the excess material occurs for supporting one or more additional dies above the bed for cutting pieces from the excess without removing the material from the machine.

3. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first cutting die, means operable to move the first cutting die transversely of the bed in a series of steps of predetermined amount commencing at one side of the sheet, said means being operable to move the die into cutting engagement with the sheet material during the intervals between steps, to cut from the sheet as many pieces of full size as possible; second means adjustably mounted on the side of the machine where the excess occurs for supporting one or more additional dies for cutting parts from the excess material without removing the latter from the machine, and means for adjusting the second means transversely with respect to the excess material.

4. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first cutting die, a head operable to move the the first cutting die transversely of the platen in a series of steps of predetermined amount commencing at one side of the sheet, a ram on the head operable to move the die into cutting engagement with the sheet material during the intervals between steps, to cut from the sheet as many pieces of full size as possible; a second bed located at the side of the machine where the excess occurs and forwardly of the first bed in the direction of movement of the material, and a secnod ram cooperable with the second bed to effect cutting pieces from the waste without removing the material from the machine.

5. Apparatus according to claim 4, wherein there is a cutter situated above the first bed operable, by cutting movement of the first cutting die, to make a cut in the sheet parallel to the direction of feed such that successive cuts lengthwise of the sheet separate the excess from the sheet thus allowing the excess to move forwardly over the second bed independently of the sheet leaving the first bed.

6. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first cutting die, a head operable to move the first cutting die transversely of the platen in a series of steps of predetermined amount commencing at one side of the sheet, a ram supported by the head operable to move the die into cutting engagement with the sheet material during the intervals between steps, to cut from the sheet as many pieces of full size as possible; and an auxiliary die-cutting machine situated at the side of the machine where the excess occurs with its bed forming a continuation of the bed of the primary machine, said auxiliary die-cutting machine having means movable into a position above its bed to effect cutting of the waste as the latter travels forwardly from the bed of the primary machine to the bed of the auxiliary machine.

7. Apparatus according to claim 6, wherein there is a cutter situated above the bed of the first cutting die operable, by cutting movement of the first cutting die, to make a cut lengthwise of the sheet parallel to its movement such that successive cuts lengthwise of the sheet separate the excess from the sheet, allowing the excess to move forwardly over the bed of the auxiliary die-cutting machine independently of the material leaving the bed of the first cutting die.

8. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first cutting die, a head operable to move the first cutting die transversely of the bed in a series of steps of predetermined amount commencing at one side of the sheet, a ram on the head operable to move the die into cutting engagement with the sheet material during the intervals between steps, to cut from the sheet as many pieces of full size as possible; means adapted to be mounted on the machine when the width of the sheet material exceeds a predetermined whole number of pieces by an amount such as to leave material at the other side for holding one or more cutting dies above said left-over material of a size to cut from said left-over material useful pieces, said means being operative, by the ram when the latter is situated at the last position of cutting, to effect movement of said means into cutting engagement with the left-over material on the bed.

9. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first cutting die, a head operable to move the first cutting die transversely of the bed in a series of steps of predetermined amount commencing at one side of the sheet, and a ram on the head operable to move the died into cutting engagement with the sheet material during the intervals between steps, to cut from the sheet as many pieces of full size as possible so as to leave a minimum of waste at the opposite side; means adapted to be mounted on the machine adjacent said opposite side of the bed when there is waste at said side for supporting one or more auxiliary cutting dies of smaller size to cut useful pieces from the waste, and means normally holding the last-named means above the bed, said means being situated in a position to be engaged by a part movable with the ram, when the latter is located at the last full cutting position, to be moved simultaneously with the first cutting die into cutting engagement with the work on the bed.

10. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first cutting die, means operable to move the

first die transversely of the bed by steps of predetermined amount commencing at one side, and a ram movable therewith operable to move the die into cutting engagement with the sheet during the intervals between steps, to cut transversely of the sheet as many pieces of said predetermined size as possible as as to leave a minimum of material left-over at the opposite side; a carrier adapted to be mounted on the machine at the opposite side above the bed at a level below the elevated position of the first die and in a position to be moved downwardly with the first die when the latter is making its cut, and one or more auxiliary cutting dies of smaller size than the first die mounted on the carrier and movable therewith into engagement with the bed when the first die is lowered into engagement with the bed.

11. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first die, means adapted to move the first die transversely of the bed by steps of predetermined amount commencing at one side, and a ram movable therewith operable to move the die into cutting engagement with the sheet during the intervals between steps, to cut transversely of the sheet as many pieces of full size as possible so as to leave a minimum waste at the opposite side; a yieldable support mounted on the machine adjacent the opposite side of the bed at a level below the raised position of the first die and extending inwardly so as to lie beneath a part of the means supporting the first die for downward movement when the first die is in the last full cutting position, said support being movable downwardly toward the bed by downward movement of said part and upwardly away from the bed when said first die is elevated, and means for securing one or more auxiliary cutting dies of smaller size and shape to said support to cut useful pieces from the left-over material simultaneously with the last full cut made by the first die.

12. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first die, means operable to move the first die transversely of the bed step-by-step and intermediate the steps to move the die into cutting engagement with the sheet material resting on the bed, to cut from the sheet material as many pieces of predetermined size as possible, commencing with one side, so as to leave a minimum waste at the opposite side; a pair of rigid rods mounted in spaced relation to each other and perpendicular to the bed adjacent the opposite side of the bed, a carrier mounted on said rods for movement vertically perpendicular to the bed, auxiliary die-supporting means removably fastened to the carrier in a position parallel to the bed, spring means yieldably supporting the carrier in a position such that the auxiliary die-supporting means is located above the bed, and means operable, by the means for effecting movement of the first die into engagement with the sheet material on the platen, to effect movement of the auxiliary die supporting means to move dies supported thereby into cutting engagement with the sheet material on the bed.

13. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first die, means operable to move the first die transversely of the bed step-by-step and intermediate the steps to move the first die into cutting engagement with the sheet material resting on the bed, to cut from the sheet material as many pieces of predetermined size as possible, commencing with one side, so as to leave a minimum waste at the opposite side; a yieldable support, means carried by the ram operative, by engagement with the support during downward movement of the ram, to lower the support and hence the auxiliary die carried thereby into engagement with the bed simultaneously with the first die, and adjustable means operative to adjust the elevation of the support so that in its uppermost position it is below the underside of said first means.

14. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first die, means operable to move the first die transversely of the bed step-by-step and intermediate the steps to move the first die into cutting engagement with the sheet material resting on the bed, to cut from the sheet material as many pieces of predetermined size as possible, commencing with one side, so as to leave a minimum waste at the opposite side; a yieldable support, means carried by the ram operative, by engagement with the support during downward movement of the ram, to lower the support and hence the auxiliary die carried thereby into engagement with the bed substantially simultaneously with the primary die, adjustable means operative to adjust the elevation of the support so that in its uppermost position it lies below the undeside of the first means, and yieldable means interposed between said first means and the support for transmitting the downward movement of said first means to the support.

15. The combination with a die-cutting machine for cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first die, and means for moving the first die transversely of the bed step-by-step and of moving the first die into engagement with the sheet material resting on the bed between successive steps, to cut transversely of the sheet as many pieces of predetermined size as possible so as to leave a minimum waste at the opposite side; spaced parallel rods supported perpendicular to the bed, a carrier mounted on the rods for movement perpendicular to the bed, an arm on said carrier located in alignment with the means supporting the first die to which a second die may be removably attached, spring means yieldingly holding the carrier in a position such that said arm is elevated from the bed, and means operable, by the means for effecting movement of the first die into engagement with the sheet material on the bed, to move a second die attached to said arm into engagement with the platen substantially simultaneously.

16. In a machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first cutting die, means operable to move the first cutting die transversely of the bed in a series of steps of predetermined amount commencing at one side of the sheet, said means being operable to move the die into cutting engagement with the sheet material during the interval between steps, to cut from the sheet as many pieces of full size as possible; and means situated at the side of the machine where the excess material occurs for making cuts lengthwise of the sheet such that the successive cuts lengthwise of the sheet separate the excess from the sheet.

17. A machine for die-cutting sheet material to form a plurality of parts of predetermined size, wherein there is a bed on which the sheet material is supported for cutting, a first cutting die, means operable to move the first cutting die transversely of the bed in a series of steps of predetermined amount commencing at one side of the sheet, said means being operable to move the die into cutting engagement with the sheet material during the interval between steps, to cut from the sheet as many pieces of full size as possible; and cutting means situated at the side of the machine where the excess material occurs operable, by cutting movement of the first cutting die, to mak a cut lengthwise of the sheet parallel to the direction of feed such that the successive cuts lengthwise of the sheet separate the excess from the sheet.

18. Apparatus according to claim **17**, wherein the cutting means comprises a cutter having a cutting edge parallel to the direction of feed and at opposite ends oppositely diverging portions so that the ends of successive cuts overlap.

19. The method which comprises cutting as many whole pieces of a predetermined size as possible from a sheet of predetermined width transversely of the sheet, and simultaneously with the last cutting operation in which a whole piece is cut from the sheet, cutting from the remainder of the sheet at that side one or more pieces of smaller size.

20. The method which comprises cutting as many whole pieces of a predetermined size as possible from a sheet of predetermined width so as to leave a minimum of waste at one side, and simultaneously with the last cutting operation in which a whole piece is cut from the sheet, cutting from the waste at the one side one or more whole pieces of different size.

21. The method which comprises cutting sheet material transversely starting at one side and crossing the sheet in steps to cut from the sheet as many whole pieces of predetermined size as possible, leaving as little waste at the other side as possible, and simultaneously with the last cutting step in which a full size piece is cut from the sheet, cutting one or more whole pieces of predetermined different size from the waste.

22. The method which comprises cutting sheet material transversely starting at one side to cut as many whole pieces transversely of the sheet as possible, leaving a minimum of waste at the other side, and simultaneously with the last cutting operation in which a whole piece is cut from the sheet, cutting one or more pieces of predetermined different size from the waste, advancing the sheet for cutting therefrom the next row starting at said other side, simultaneously with the first cutting operation in the reverse direcion in which a whole piece is cut from the sheet, cutting one or more pieces of said predetermined different size to use up the waste as the first step in the return cutting operation, and then continuing to cut whole pieces transversely of the sheet to the one side.

23. In a die-cutting operation on sheet material in which a die is moved transversely of the sheet across and back and the sheet is advanced between transverses, the method of commencing at one side and cutting as many whole pieces transversely from the sheet as possible, and during the last full cutting operation at the opposite side simultaneously cutting from the excess at that side useful whole pieces of predetermined different size, advancing the sheet preparatory to commecing the cutting transversely of the sheet from said other side to the one side, at the first full cutting operation on the return traverse simultaneously cutting from the excess at said other side useful pieces of said predetermined size, and then continuing to cut whole pieces transversely of the sheet to the one side.

24. The method which comprises cutting as many whole pieces of predetermined size as possible from a sheet of predetermined width so as to leave a minimum of excess at one side, and simultaneously with the last cutting operation in which a whole piece is cut from the sheet, making a cut lengthwise of the sheet such that successive lengthwise cuts separate the excess throughout the entire length of the sheet therefrom.

25. The method which comprises cutting as many whole pieces of predetermined size as possible from a sheet of predetermined width so as to leave a minimum of excess at one side, and simultaneously with the last cutting operation in which a whole piece is cut from the sheet, making cuts lengthwise of the sheet, the ends of which deviate in opposite directions transversely with respect to the direction of movement of the sheet so that successive lengthwise cuts overlap to separate the entire excess throughout the length of the sheet therefrom.

No references cited.

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