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(54) Adjustable die assembly

(57) The invention relates to a die assembly for a sheet metal forming machine comprising a base plate (1) and two half die bodies (2,3) which are moveable with respect to each other to provide an adjustable die width (4) between jaws (5,6) borne by said half die bodies, said half die bodies being each obliquely moveable with respect to the centre plane (Y,Z) of the die assembly between said jaws (5,6), wherein a first half die body (2) is arranged on the base plate (1), linearly moveable according to an angle alpha with respect to said centre plane (Y,Z), and a second half die body (3) is arranged on said first half die body (2) linearly moveable at an angle 2 times alpha with respect to said centre plane (Y,Z).

The base plate (1) and the half die bodies (2,3), in particular the back die body (1) and front die body (3), may be provided with cooperating obliquely arranged keys (7,10) and oblique slots (8,9; 11,12) allowing an oblique movement of the first half die body (2) with respect to the base plate (1) and of the first half die body (2) with respect to the second half die body (3).

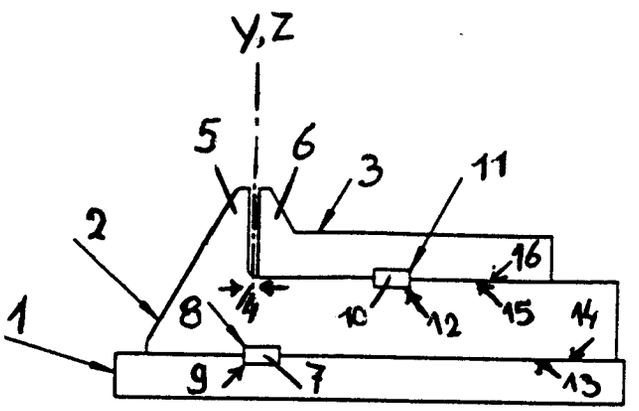

Fig 1a

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Description

The invention relates to a die assembly for sheet metal forming machines, such as edging or folding presses. The invention more specifically relates to the so called "lower tools" of such assembly and in particular to laterally adjustable die jaws, pads or abutments of such lower tools.

Lower tools comprising displaceable jaws or pads so that the die width can be adjusted are for instance known from US patent 5,564,301. In this lower tool assembly separate die halves are obliquely displaceable in an horizontal plane, symetrically with respect to the centre line of the die assembly. The die halves can be displaced with respect to each other by means of obliquely arranged slots and keys at the upper sliding surface of a base plate of the lower tool and at the lower sliding surfaces of the die halves.

The features of this adjustable die assembly offer certain advantages over previously known adjustable dies, but still present a number of drawbacks from the point of view of construction complexity and cost, and from the point of view of operation easiness.

It is a purpose of the present invention to overcome these drawbacks and to provide further improvements with respect to the known adjustable die assemblies for sheet metal forming machines, such as edging or folding presses.

The invention accordingly provides a die assembly for a sheet metal forming machine comprising a base plate and two half die bodies which are moveable with respect to each other to provide an adjustable die width between the jaws of said half die bodies, said half die bodies being each obliquely moveable with respect to the centre plane of the die assembly between said jaws, wherein a first half die body is arranged on the base plate, linearly moveable according to an angle alpha with respect to said centre plane, and a second half die body is arranged on said first half die body linearly moveable at an angle 2 times alpha with respect to said centre plane.

According to a preferred feature of the invention the first and second die body and the base plate are provided with cooperating obliquely arranged keys and oblique slots.

By the arrangements thus defined, a movement of the first half die body in the longitudinal direction, i.e. parallel to the centre plane of the die assembly, can be combined with a transversal movement, i.e. a movement perpendicular to the centre plane of the die assembly, of the first half die body, and simultaneously also of the second half die body, but in opposite direction.

In a specific embodiment of the invention, it is more in particular the back half die body of the die assembly which is arranged on the base plate of the die assembly, whereas the front half die body is arranged on the back half die body.

According to further preferred features of the invention, the upper surface of the base plate is provided with at least one oblique slot, lying at an angle alpha with respect to the centre plane of the die assembly, and the bottom surface of the first half die body (preferably the back die) is provided with one or more corresponding oblique slots also lying at an angle alpha with respect to the centre plane, whereas a number of keys provided in said slots allow an oblique movement of the first half die body (preferably the back die) with respect to the base plate; the upper surface of the first half die (preferably the back die) is provided with at least one oblique slot, lying at an angle 2 times alpha with respect to the centre plane, and the bottom surface of the second half die body (preferably the front die) is provided with one or more corresponding oblique slots also lying at an angle 2 times alpha with respect to the centre plane, whereas a number of keys provided in said slots allow an oblique movement of the first half die body (preferably the back die) with respect to the second half die body (preferably the front die).

According to still another particularly usefull feature of the invention the die assembly may comprise means to move the first half die body along a longitudinal direction parallel to the centre plane of the die assembly, and means to retain the second half die body in fixed position in said longitudinal direction, so that a movement of the first half die body along said longitudinal direction results in a symetric movement of the two half die bodies with respect to each other in the transversal direction perpendicular to the centre plane of the die assembly.

By this arrangement, a movement of the first half die body (preferably the back die) in the longitudinal direction, i.e. parallel to the centre plane of the die assembly, automatically results in a corresponding transversal movement, i.e. a movement perpendicular to the centre plane, of the first half die body (preferably the back die), and a simultaneous, symetric (i.e. in opposite direction) transversal movement of the second half die body (preferably the front die) over the same distance

The particular construction according to the present invention makes it possible to avoid the inherent drawback of the known constructions according to which the oblique slots must necesserily entirely lie outside the broadest die width, automatically resulting in a die assembly with very broad half dies, at the front as well as at the back. At the front side this does not constitute so much a problem, but at the back side it prevents making Z-folds in the metal sheets. In the novel principle of die construction according to the present invention the width necessary for the oblique slots can lie entirely underneeth the die width. The back die can thus remain narrow so that making Z-folds in the metal sheets is not hindered.

A further advantage of the new principle resides in the fact that only one half die has to be moved longitudinally. This is easier and cheaper to achieve than having

to move both half dies. Additionally, according to the new principle, only the back die has to be extended for the length corresponding to the longitudinal movement of the die, whereas in the known construction both half dies have to be considerably longer than the folding length.

The invention will be further explained herebelow with reference to the attached drawings representing a preferred embodiment of the invention. It should be observed that the specific features of this embodiment are only described as preferred examples of what is intended within the above general disclosure of the invention and should by no means be interpretted as limitting the scope of the invention as such and as set forth in the claims.

In the drawings :

Figure 1a represents a transverse sectionnal view of one embodiment of a lower tool assembly according to the invention, shown with an adjusted narrow die width;

Figure 1b represents a top view of the lower tool assembly shown in figure 1a;

Figure 2a represents a transverse sectionnal view of the same lower tool assembly according to the invention, shown with an adjusted broad die width;

Figure 2b represents a top view of the lower tool assembly shown in figure 2a;

Figure 3a represents a transverse sectionnal view of another embodiment of a lower tool according to the invention, shown with an adjusted narrow die width;

Figure 3b represents a top view of the lower tool assembly shown in figure 3a;

Figure 4 represents a top view of the lower tool assembly of figures 3a and 3b, shown with an adjusted broad die width;

Figure 5 represents a transverse sectionnal view of a lower tool assembly of the known type referred to hereabove in the discussion of the state of the art.

The lower tool assembly for a sheet metal forming machine, according to the invention, shown in figures 1 and 2, comprises a base plate (1) having an upper surface (13) supporting the lower surface (14) of a back half die body (2). The back half die body (2) has an upper surface (15) supporting the lower surface (16) of a front half die body (3).

The upper surface (13) of the base plate(1) and the lower surface (14) of the back half die (2) are respectively provided with one oblique slot (9) and one oblique slot (8) - at an angle alpha with respect to the longitudinal direction of the lower tool assembly - cooperating with keys (7) to bring about a transverse movement of the back half body (2) with respect to the base plate (1) - i.e. a movement perpendicular to the centre plane (Y,Z) of the lower tool assembly - when a longitudinal movement - parallel to the centre plane (Y,Z) - is imparted to the back half die (2).

The upper surface (15) of the back half die (2) and the lower surface (16) of the front half die (3) are respectively provided with one oblique slot (12) and one oblique slot (11) - at an angle 2 alpha with respect to the longitudinal direction of the lower tool assembly - cooperating with keys (10) to bring about a transverse movement of the front half body (2) with respect to the back half body (2) (and with respect to the base plate (1)) - i.e. a movement perpendicular to the centre plane (Y,Z) of the lower tool assembly - when a longitudinal movement - parallel to the centre plane (Y,Z)- is imparted to the back half die body (2).

As clearly illustrated by a comparison of figures 1a and 2a, and figures 1b and 2b respectively, the width (4) between jaw (5) of the back half die body (2) and jaw (6) of the front half (3) die body can be adjusted by moving the back half die in the longitudinal direction, whereas the front half die body is maintained in place in the longitudinal direction. Cooperation of the slots and keys of the base plate and the half die bodies results in a simetric movement of the two half die bodies with respect to each other, namely a movement of the the back die body (2) perpendicular to the centre plane (Y,Z), and a simultaneous, symetric (i.e. in opposite direction) transversal movement of the front die body (3) over the same distance.

Figures 3a, 3b and 4 illustrate another embodiment of the invention in which several parallel oblique slots - two in the present case - (11) and (11') are provided in the upper surface (15) of the back half die body (2), cooperating with several parallel keys - two in the present case - (10) and (10') provided to the lower surface (16) of the front half die body (3) - either directly or in corresponding slots in the front half die body (not represented)-.

As illustrated by a comparison of figures 3b and 4, the width (4) between the jaws of the half die bodies (2) and (3) can be adjusted by moving the back half die in longitudinal direction, whereas the front half die body is maintained in place, in a similar way as explained above in respect of the embodiment of figures 1 - 2.

Whether one slot and die or several slots and dies are most appropriately provided for the relative movement of the base plate / back half die and/or of the back half die / front half die will depend on the dimensional circumstances and the adjustability requirements of the lower tool assembly considered, and will easily be figured out by the skilled art worker.

A representation of a lower tool assembly of the know type, as referred to hereabove in the discussion of the state of the art, is given in figure 5 to illustrate the more compact construction of a lower tool assembly according to the principle of the present invention. In such devices according to the state of the art principles, both the back half die (2) and the front half die (3) have to be sufficiently broad to accommodate the oblique slots which must necesserilly extend beside the entire

die width. It is clear that the die assembly according to the invention presents a considerable advantage also from this point of view.

Claims

1. Die assembly for a sheet metal forming machine comprising a base plate (1) and two half die bodies (2,3) which are moveable with respect to each other to provide an adjustable die width (4) between jaws (5,6) borne by said half die bodies, said half die bodies being each obliquely moveable with respect to the centre plane (Y,Z) of the die assembly between said jaws (5,6), **characterised in that** a first half die body (2) is arranged on the base plate (1), linearly moveable according to an angle alpha with respect to said centre plane (Y,Z), and a second half die body (3) is arranged on said first half die body (2) linearly moveable at an angle 2 times alpha with respect to said centre plane (Y,Z).

2. Die assembly according to claim 1, **characterised in that** the back half die body (2) of the die assembly is arranged on the base plate (1) of the die assembly, and the front half die body (3) of the die assembly is arranged on the back half die body (2) of the die assembly.

3. Die assembly according to any one of the preceding claims, **characterised in that** said first half die body (2) and said base plate (1), and, respectively, said second half die body (3) and said first half die body (2) are provided with cooperating obliquely arranged keys (7,10) and oblique slots (8,9; 11,12).

4. Die assembly according to any one of the preceding claims, **characterised in that** the upper surface (13) of the base plate (1) is provided with at least one oblique slot (8), lying at an angle alpha with respect to the centre plane (Y,Z) of the die assembly, and the bottom surface (14) of said first half die body (2) is provided with one or more corresponding oblique slots (9) also lying at an angle alpha with respect to the centre plane (Y,Z) of the die assembly, whereas a number of keys (7) provided in said slots (8,9) allow an oblique movement of the first half die body (2) with respect to the base plate (1).

5. Die assembly according to any one of the preceding claims, **characterised in that** the upper surface (15) of the first half die (2) is provided with at least one oblique slot (11), lying at an angle 2 times alpha with respect to the centre plane (Y,Z) of the die assembly, and the bottom surface (16) of said second half die body (3) is provided with one or more corresponding oblique slots (12) also lying at an angle 2 times alpha with respect to the centre plane (Y,Z) of the die assembly, whereas a number of keys (10) provided in said slots (11,12) allow an oblique movement of the first half die body (2) with respect to the second half die body (3).

6. Die assembly according to any one of the preceding claims, **characterised in that** it comprises means to move the first half die body (2) along a longitudinal direction parallel to the centre plane (Y,Z) of the die assembly, and means to retain the second half die body (3) in fixed position in said longitudinal direction, so that a movement of the first half die body (2) along said longitudinal direction results in a symetric movement of the two half die bodies (2,3) with respect to each other in the transversal direction perpendicular to the centre plane (Y,Z) of the die assembly.

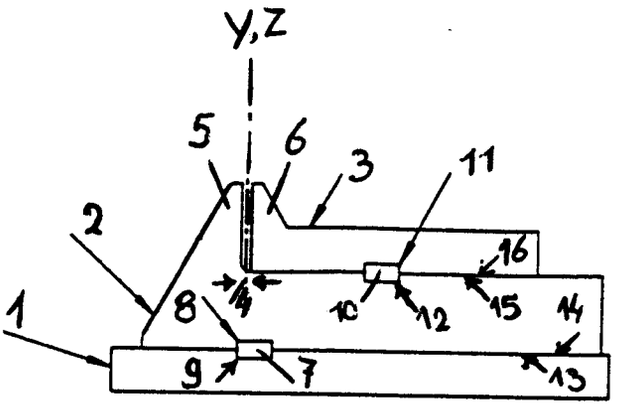


Fig 1a

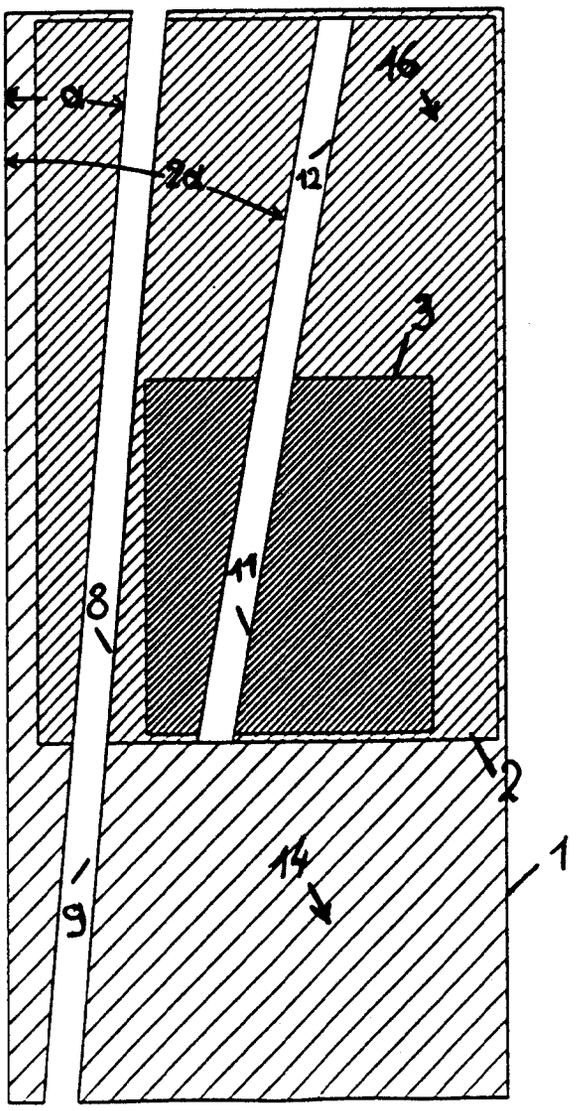


Fig 1b

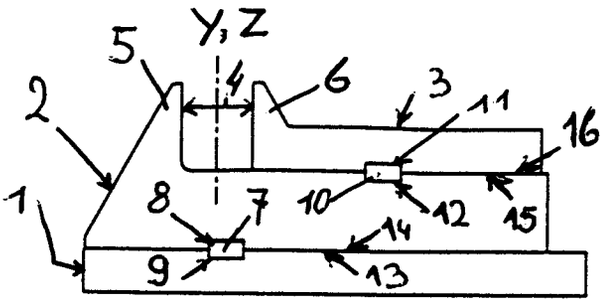


Fig 2a

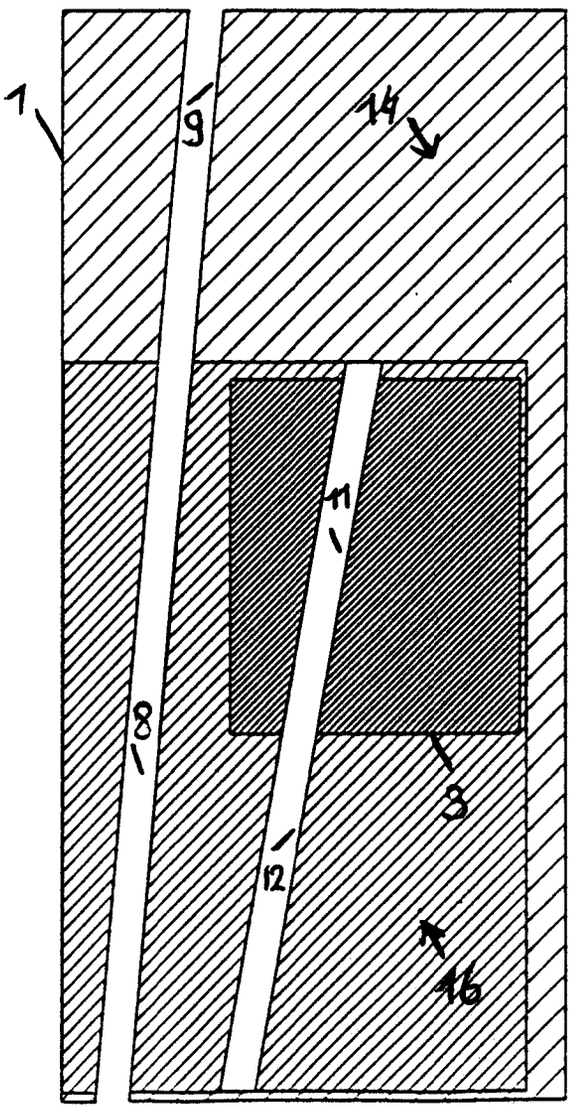
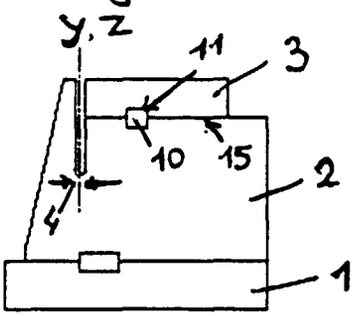


Fig 2b

Fig 3a



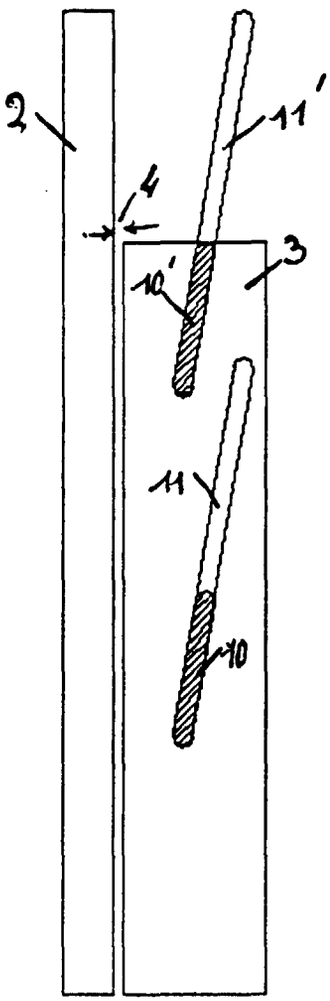
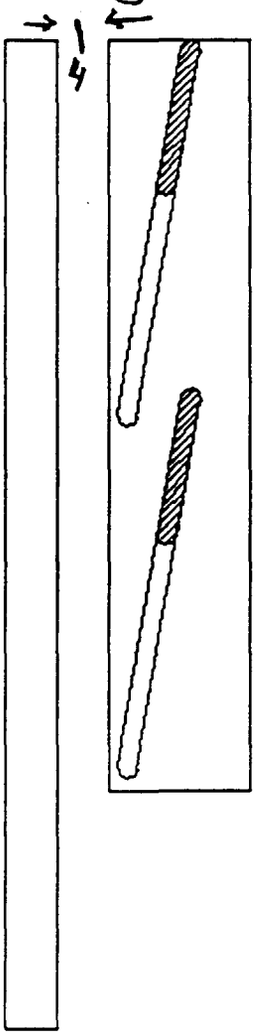


Fig 3b

Fig 4



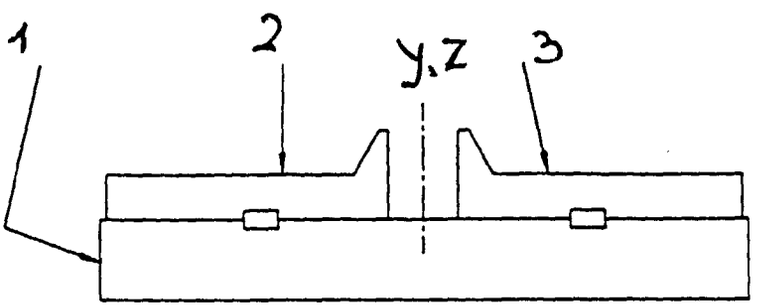


Fig 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 20 0800

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A,D	WO 94 09924 A (NYA URSVIKENS MEKANISKA VERKST ;ROENNMARK ULF (SE)) 11 May 1994 * the whole document * ---	1	B21D5/02
A	US 4 106 323 A (HAENNI EDUARD A ET AL) 15 August 1978 * figures 2,3 * -----	1,2,5	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 August 1997	Ris, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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