



46 466 b A PUNCH PRESS INCLUDING AT LEAST ONE TOOL UNIT

BACKGROUND OF THE INVENTION

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FIELD OF THE INVENTION

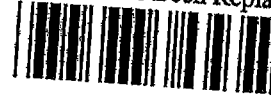
The present invention relates to a punch press including at least one tool unit, and having at least one ram and a machine frame which machine frame includes ram guiding devices, which ram is guided in the machine frame by these ram guiding devices, which tool unit includes an upper tool unit part and a lower tool unit part and a arrangement of further guiding devices by means of which the upper tool unit part is guided in the lower tool unit part for movement in a direction of stroke of the ram.

DESCRIPTION OF THE PRIOR ART

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The development of modern punching techniques is aimed at achieving a complete processing of a raw material, i.e. a complete chip-less producing of end products. This means that a punch press including the corresponding tool will be structured in such a manner that it is a complete production center by itself. Apart from the conventional cutting and shaping (bending) operations, punch presses and corresponding tools are increasingly used for performing mounting and assembling operations, welding and riveting operations are performed and, furthermore, threads are formed in workpieces. Correspondingly made products or punched products, resp. comprise a large number of shaped portions and necessitate accordingly a growing number of subsequent opera-

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tions, i.e. production steps. This leads to the need of constantly growing lengths of the tools and conclusively to longer punch presses. Long tools can lead to various drawbacks. The precision of the product produced may suffer and thermal expansions may cause considerable troubles, which regarding the design of such elongate tools, the mounting of which in the punch presses and an obtaining of extremely precise products can be extremely difficult to control, if at all.

10 Due to above reasons a module-type design of tools has firmly been established in the art. Each module forms a complete tool unit having a upper tool unit part and a lower tool unit part and performs a number of operating steps, but not all operating steps, on the strip or web
15 shaped band which is worked upon. This means that a plurality of tools arranged in succession in the direction of the feed or movement, resp. of the strip moving through the punch press are mounted in such punch press, which modules form together in relation to the total processing operation of such
20 strip a long multiple press tool. In each single module the upper tool part which moves when the punch press is in operation is guided relative to the lower tool part by guiding columns and column guides, whereby the upper tool part includes guiding members which move when the punch press is in
25 operation and are designed as guiding columns which are guided in stationary guiding members in the lower tool part which are designed as columns guides, i.e. the guiding columns are guided at guiding locations in the column guides, and because conventionally four guiding columns and four columns guides a present, these guiding locations define together the so called guiding plane.

The advantage of the module-design is generally a more economical production of the tools, an easy exchange of



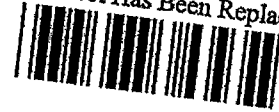
tools (e.g. for re-sharpening of some worn parts of the tool), and a more simple handling of the modules.

According to conventional designs the individual modules are mounted in a master frame having an upper master
5 frame part and a lower master frame part, which master frame includes in turn own column guiding structures.

That is, the upper master frame part includes guiding members which move when the punch press is in operation and are designed as guiding columns, and the lower master
10 frame part includes guiding members which are stationary when the punch press is in operation and are designed as column guides. Accordingly, such master frame features further guiding locations which together define a further guiding plane, namely the guiding plane of the master frame. When
15 mounted in the punch press the upper master frame part of the master frame is mounted to the ram of the punch press and the lower master frame is mounted to the clamping plate which in turn is firmly mounted to the frame of the punch press. If
20 extremely precise punched products are to be produced and thus the cutting clearance, i.e. the distance between the outer circumference of a punch and the inner circumference of the corresponding bottom die must be extremely small, the upper tool part of the respective module is often supported in the upper master frame part in a laterally displaceable manner.
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The ram of the punch press which performs stroke movements when the punch press is in operation is equipped with guiding columns which are guided in column guides in the machine frame. Accordingly, the punch press features also
30 guiding locations (in the column guides) which in turn define a further i.e. a third guiding plane.

Conclusively, a punch press which comprises tools consisting of a plurality of modules features three guiding



planes. The first guiding plane is defined by module guiding members between the upper tool module part and the lower tool module part. The second guiding plane is defined by the master frame guiding members between the upper master frame part and the lower master frame part of the master frame. The
5 third guiding plane is defined by the ram guiding members between the ram and the frame of the punch press.

Modern punch presses operate at high speeds, i.e. a high number of strokes per time unit. This fact lead to
10 higher losses due to friction and thus to an increase of the total temperature of the punch press. Efforts are made to achieve a uniform heating of the individual structural members of punch presses and it is generally known to enlist for this task heating and cooling apparatuses. However, the gen-
15 eration of a temperature difference between the ram of the punch press and its frame upon reaching the operating temperature after the start-up phase of the punch press can not be avoided. The accordingly differing thermal expansions leads to an extremely undesired state of jamming stress load-
20 ings at the individual guiding members described above and to a quite undesired displacing between e.g. a punch and corresponding bottom die of the tools. Jamming stress loaded guiding structures cause increased losses due to friction, an increased power consumption, an earlier wear of the respective
25 structural members and in case of small cutting clearances for high precision products an increased wear of the tools.

SUMMARY OF THE INVENTION

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Thus, it is a general object of the present invention to provide a punch press including at least one tool unit which necessitates a minimal number of bearing locations



for a guiding in the direction of the stroke of the ram of the punch press and by means of which differing thermal expansions can be coped with practically without any losses in that the upper tool unit portion of the tool unit is mounted
5 by mounting members directly to a portion of the ram of the punch press, which allow exclusively a displacing between the upper tool unit portion and the ram in a direction extending laterally to the direction of the stroke of the ram.

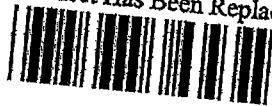
A further object is to provide a punch press in
10 which its ram includes a ram portion which is mounted by mounting units which are structured as guiding elements directly to the upper tool unit part of a respective tool unit, which guiding elements are structured to allow exclusively a relative movement between the ram and the upper tool unit
15 part which is directed perpendicularly to the direction of stroke of the ram.

The advantages to be gained by the invention are to be seen substantially in that the tool unit is guided in one single plane only and accordingly jamming stress loadings
20 and losses due to friction at the guiding structures are reduced considerably. At the punch press including the tool units mounted therein these tool units are directly mounted to a portion of the ram of the punch press, so that differing thermal expansions between the ram and the machine frame and
25 also jamming stress loadings and losses due to friction are considerably reduced. Furthermore, the moving masses of any tool unit and of the punch press are reduced.

30 BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above will become apparent

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when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings, wherein:

Figure 1 is a view of a portion of a punch press in which the tools are received, of the ram and of the clamping plate and alignment plate thereof, illustrated partly in section and partly in a sideview;

Figure 2 is a section along line II-II of figure 1;

Figure 3 is a view similar to the view of figure 1, illustrating a punch press having an extremely long space for the receipt of tools,

Figure 4 is a section along line IV-IV of figure 3;

Figure 5 is a section through a tool unit module along line V-V of figure 6; and

Figure 6 is a section along line VI-VI of figure 5.

Figure 1 illustrates the ram 1 of a punch press which ram 1 is pivotally mounted as conventional to pressing columns 2, which in turn are pivotally mounted to single arm levers 3. The single arm levers 3 are pivotally mounted at one of their ends to a connecting rod 4 which is supported according to conventional designs on a (not particularly) illustrated eccentric shaft portion or crank shaft. At their opposite end the single arm levers 3 are pivotally mounted to mechanisms 5 for the adjusting of the height position of the ram. In operation of the punch press the rotating movement of the eccentric shaft portion or the crank shaft is transformed by the connecting rod into a translatic movement which is transferred by the single arm levers 3 to the ram 1. The above described arrangement and operation including the adjusting of the height position of the ram is generally known



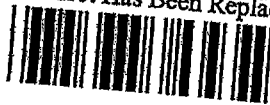
to the person skilled in the art and must, therefore, not be described in detail.

The ram is mounted to guiding columns 6 which are guided in column guiding devices 7. This guiding arrangement consisting of guiding columns 6 and column guiding devices 7 and its operation is disclosed in the CH-PS 568 848 or US-PS 3 998 498, resp., which disclosures shall be considered as incorporated herein by reference. The specific arrangement of the column guiding devices 7 and specifically the orientation of their gliding surfaces is disclosed in Figure 2. The so-called guiding plane which is defined by the guiding columns 6 and column guiding devices coincides with the plane of the movement of advance of the sheet material web being processed, which plane is identified in Figure 1 by the two portions of the section line II-II. The column guiding devices 7 are firmly mounted to the machine frame 8. A clamping plate 9 is bolted onto the machine frame 8. Furthermore, a alignment plate 10 is bolted in turn to the clamping plate 9. The ram illustrated in the Figures includes a lower portion 11 which is of a plate like design and is rigidly mounted to the ram part 1. It shall be, however, distinctly noted that the entire ram 1, 11 can be one single integral structure, such that the parts 1, 11 form a undivided body.

In the following description the thermal expansions of the punch press when in operation will be explained.

The basic direction of the thermal expansion from point o (Fig. 1) proceeds in the direction of the arrows a and b (and also vice versa). Obviously those tool units 12 which are located furthest from point o will experience the largest influence by the change of the length of ram 1 to which they are mounted (in comparison with tool units which are closer to the point o). As will be shown further below, these tool units 12 are designed as moduls.

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Considering now figure 2 it will become obvious that due to the column guiding devices the thermal expansion can proceed from the points e and d exclusively in the direction of the arrows e, f, g and h, i, j (see the above mentioned CH-PS 568 848 and US-PS 3 998 498), whereby considerable pressure stresses which lead to jamming stress loadings in the guiding members of the ram occur in the direction of the arrows g and j, and this specifically in case of long rams.

10 A punch press having a very long space for a mounting of tools, i.e. a corresponding long ram, is illustrated in Figures 3 and 4. This punch press is extensively described in the published European Patent Application EP-A-724 953 which publication shall be considered as incorporated
15 herein by reference. With regard to the present discussion it is merely to be noted that mentioned punch press includes two rams 13 and 14 arranged in succession in relation to the direction of movement of the web to be processed in the punch press.

20 The drive of the punch press here under consideration proceeds from the connecting rod 4 via the single arm levers 3, 3'. Connecting links 29, 30 are pivotally mounted to the single arm levers 3, 3', which connecting links 29, 30 are in turn pivotally mounted to double arm levers
25 31,32,33,34. These double arm levers 31,32,33,34 act via the pressing columns 35,36,37,38 onto the rams 13,11 and 14,11'. The rams 13,11 and 13,11' are guided at three locations, whereby the two outermost guiding devices illustrated in the figures 3 and 4 are of the same design as the guiding devices
30 illustrated in Figures 1 and 2.

Attention is drawn, however, to the ram guiding devices 15 and 16. The rams 13,11 and 14,11' can expand freely from the points o,o' in direction of the arrows k,l,m



and n,o,p, whereby the tool unit moduls 12 which are furthest from the points o,o' are those which are subjected to the largest extent to the changes of the length of the rams 13,11 and 14,11' and they can expand specifically freely unimpeded
5 in the direction of the arrows m and n.

With reference to Figures 5 and 6 a preferred embodiment of a tool unit structured in accordance with the invention will now be described, which counteracts mentioned drawbacks and is constructed as one of the several moduls
10 mounted in the punch press.

The module 12, i.e. the tool unit includes a upper tool unit part 17. This upper tool unit part 17 abuts or contacts, resp. directly the bottom side of the ram 1,11, whereby in the illustrated embodiment the ram portion 11 is
15 designed as a plate which is bolted to the rest portion 1 of the ram, which bipartite design of the ram is not mandatory. The plate 11 may as well be a integral portion of the entire ram.

The lower tool unit part 20 is rigidly bolted in
20 a way still to be described by means of threaded bolts 21,22 to a alignment plate 10 which in turn is bolted by threaded bolts 23,24 to the clamping plate 9.

The illustrated module 12 is an exemplary design of a tool and as generally known to the person skilled
25 in the art there is a large number of differing designs of tools for punch presses, depending from the specific work to be performed on the web to be processed.

The module 12, i.e. tool unit, includes as upper tool unit part 17 a punch supporting and pressing plate 25
30 whereby a punching tool 26 is set into this plate, and includes a guiding and stripper plate 27.

The lower tool unit part 20 includes a cutting and pressing plate 28.

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Four guiding columns 65,66,67,68 are pressed into the plate 25. These guiding columns 65,66,67,68 are guided in play-less column guiding devices 39,40,41,42 in the lower tool unit parts 20. These guiding devices are designed as
5 linear ball bearings.

The guiding and stripper plate 27 is also guided by means of linear ball bearings 45 at the guiding columns 65,66,67,68. The punching tool 26 which is mounted to the supporting plate 25 projects through this guiding plate 27.
10 The guiding plate 27 has threaded bolts 43 screwed thereinto by means of which it is supported in the punch supporting plate 25, and is, furthermore, biased away from the supporting plate 25 by pressure springs 44. The guiding structures 39-42 and 45 allow an optimal cutting slot distribution between the punching tool 26 and the bottom die 46 in the lower
15 tool 20. The reference numeral 47 designates the sheet metal web being processed, i.e. worked upon.

The assembling proceeds in that each module 12 including the upper tool unit part 17 set into the lower tool
20 unit part 20, is placed onto the alignment plate 10 and in order to achieve a initial coarse alignment it is slid against the abutments 48,49 to contact same for a coarse aligning.

Precise bore holes 50 are formed in the alignment
25 plate 50 and precise positioning bore holes 51 are formed in the cutting and pressing plate 28. After the module 12 has been coarsely aligned by means of the abutments 48,59 the positioning bore holes 50,51 are aligned precisely and thereafter extremely precisely worked positioning sleeves 52 are in-
30 serted through the positioning bore holes 51 and into the positioning bore holes 50, so that the lower tool unit part 20 is positioned exactly on the alignment plate 10 and conclusively is aligned with the upper tool unit part 17. Thereaf-



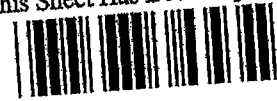
ter, the securing is accomplished by means of tightening the threaded bolts 21,22 which serve, however, merely as connecting members between the lower tool unit part 20 and the alignment plate 10 and not as laterally acting guiding elements.

The upper punch supporting and pressing plate 25 is fastened by means of threaded bolts 58 to the plate 11, i.e. directly onto a portion of the ram of the punch press, which threaded bolts 58 are surrounded by sleeves 54. Bore holes 55 are formed in the punch supporting and pressing plate 25. For a initial coarse aligning of the plate portion 11 relative to the punch supporting and pressing plate 25 (not particularly illustrated) auxiliary sleeves are made use of, of which the outer diameter corresponds to the inner diameter of the bore holes 55. Thus, the ram is aligned and centered relative to the upper tool unit part 17.

Thereafter, the threaded bolts 58 are loosened and the auxiliary sleeves which were used for the above adjusting are replaced by sleeves 54 of which the outer diameter is smaller than the inner diameter of the bore holes 55, such that a clearance is present which allows a horizontal displacing. The length of the sleeves 54 is selected in relation to the thickness of the flanges 56 in such a manner that after the threaded bolts 58 have been tightened with a predetermined torque, a minimal clearance is present between the supporting rings 57 seated on the head of the threaded bolts 58 and the flange 56.

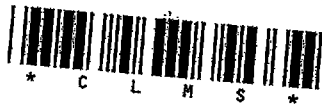
Thus, lateral shifting movements of the ram 1,11 relative to the upper tool unit part 17 can be absorbed without the occurring of stress loadings between the modul guiding devices 39, 45 and the column guiding devices 15, 16 and any displacing between the punching tool 26 and the bottom die 46 is impossible.

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If the mentioned ram portion is structured as a separate plate 11 a given ram could be provided with several such plates. In the same manner the alignment plate 10 could consist of several parts, in which case each "plate portion"
5 11 and each "alignment plate portion" 10 would support a portion of the totality of the modules 12.

While there is shown and described a present preferred embodiment of the invention, it is to be distinctly understood that the invention is not limited thereto, but may
10 be otherwise variously embodied and practiced within the scope of the following claims.



PATENT CLAIMS

1. A punch press including at least one tool
5 unit, and having at least one ram and a machine frame which
machine frame includes ram guiding devices, which ram is
guided in the machine frame by said ram guiding devices,
which tool unit includes an upper tool unit part and a lower
10 tool unit part and an arrangement of further guiding devices
by means of which the upper tool unit part is guided in the
lower tool unit part for movement in a direction of stroke of
the ram; said ram comprising a portion which is mounted by
mounting units which are structured as guiding elements di-
rectly to the upper tool unit part of a respective tool unit,
15 which guiding elements are structured to allow exclusively a
relative movement between the ram and the upper tool unit
part which is directed perpendicularly to the direction of
stroke of the ram.

2. The punch press having at least one tool unit
20 as claimed in claim 1, wherein said portion of the ram which
is mounted to the upper tool unit part of a tool unit is a
plate member against which the upper tool unit abuts in a
laterally displaceable manner, which plate unit which is
mounted to a respective tool unit is guided exclusively by
25 the ram guiding devices against a lateral displacing move-
ment, so that the entire means for performing guiding func-
tions in the punch press consists of the ram guiding devices
and the arrangement of guiding devices by means of which the
upper tool unit part is guided in the lower tool unit part.

30 3. The punch press of claim 2 and having a plu-
rality of module-like structured tool units, wherein the up-
per tool unit parts of a plurality of tool units are mounted
to one and the same plate member common to all, and laterally



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displaceable relative to the plate member independently from each other, which plate member which is mounted to the upper tool unit parts of a plurality of tool units is guided regarding its position in a horizontal direction exclusively by
5 the guiding columns and guiding devices for the guiding of the ram.

4. The punch press of claim 3, wherein each lower tool unit part is arranged in a plate shaped supporting member, and wherein a plurality of first positioning bore holes
10 is formed in each lower tool unit part and a plurality of second positioning bore holes in formed in the plate shaped supporting member, which second positioning bore holes are aligned with the first positioning bore holes, further wherein any respective first and second positioning bore
15 holes allocated to each other are aligned relative to each other by a positioning sleeve common to both and which is set into the respective first and second bore holes, so that the lower tool unit part is precisely positioned on the plate shaped supporting member and conclusively also relative to
20 the upper tool unit part.

5. The punch press of claim 4, wherein said mounting units which are structured as guiding elements include bore holes formed in flanges of a structure portion of the upper tool unit part, and include supporting bolts which
25 are surrounded by sleeves and project from said portion of the ram and extend through said bore holes, further wherein the outer diameter of said sleeves is smaller than the inner diameter of said bore holes, and wherein a supporting ring is located at the end of the supporting bolts remote from said
30 portion of the ram, which structure portion of the upper tool unit part rests at its flanges on said supporting ring, so that said structure portion of the upper tool unit part is



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located laterally displaceable directly at said portion of the ram.

6. The punch press of claim 1, comprising a plurality of module-like tool units arranged in succession in a direction of feed of a workpiece to be worked upon in the punch press, which module-like tool units form together a multiple press tool arrangement.

7. The punch press of claim 1, comprising at least two rams arranged in succession in a direction of feed of a workpiece to be worked upon in the punch press.