

A method of and an apparatus for measuring
and controlling the height position of the
ram of a high-speed punch press

5 The present invention relates to a method of
measuring and controlling the height position of the ram
of a high-speed punch press having a lower tool and an
upper tool which is movable relative to the lower tool,
and is mounted to the ram, for a cutting, punching, bend-
10 ing and/or embossing working of a web-shaped raw mate-
rial, which ram moves in operation of the punch press be-
tween a bottom dead centre position and a top dead centre
position. The invention further relates to an apparatus
for practising this method, whereby the punch press in-
15 cludes an adjusting device for a changing of the height
position of the ram during operation, which adjusting de-
vice is controlled by a control apparatus.

 The working operations at the web-shaped raw
material are performed in punch presses when the ram runs
20 through the area of the bottom dead centre of its move-
ment. Decisive regarding the working of the raw material,
regarding wear of parts of the tools, regarding loading
of the entire punch press is accordingly generally the
state regarding the position of the ram when it is lo-
25 cated in the mentioned area of the bottom dead centre,
and deviations of the ram from its design position in the
bottom dead centre lead to a variety of drawbacks. Such
deviations occur specifically in high-speed punch
presses, e.g. by speeds of over 600 strokes per minute
30 due to a changing of the speed of rotation, which lead to
dynamic influences relative to the position of the ram in
the bottom dead centre and, furthermore, such deviations
can be produced by thermal influences. In punch presses
which are equipped with tools without any fixed stops, it
35 is generally known that with an increasing speed of op-
eration and also an increasing temperature, the penetra-
tion depth of the upper tool in the corresponding lower

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tool increases likewise, which leads on the one hand to increased wear of the tools, and on the other hand to a loss with regard to precision in the case of bending and embossing operations.

5 If the production requires an extremely high precision, the tools are often equipped with fixed abutment stops. These abutment stops generally have the function to enforce a given tool closed position under all circumstances, that is e.g. number of strokes, temperature, etc. In other words, the position of the ram is
10 maintained under all conditions unchangeably and fixed in its bottom dead centre. This means that due to the pressure forces present at the fixed abutment stops when the ram is in its bottom dead centre position, the punch
15 press is stressed or loaded, respectively, when the ram is in its lower dead centre position already only when it is at rest. Specifically at increasing rotational speed the pressure forces present in the abutment stops can rise to an amount several times of the amount in the
20 static state. The punch press is accordingly loaded by additional influences of forces which do not take part at the punching operation proper and thus are quite undesirable.

 In order to counteract the mentioned difficulties, several suggestions have been made to measure
25 the distance between the upper tool and the lower tool, or between the ram and the work table, respectively, at the lower dead centre position of the ram and to adjust, based on the measured values obtained, the height position of the ram. Now, it is quite obvious that with the
30 known measuring devices, when operating with fixed abutment stops, deviations in the bottom dead centre position cannot be measured because it is the fixed abutment stops which forcibly set or determine, respectively, the bottom
35 dead centre position.

 Here the invention intends to provide a remedy. The invention, such as is characterized in the



claims, solves the object to provide a method and an apparatus by means of which the position of the ram can be measured in its bottom dead centre position without it being absolutely necessary to scan the position of the ram in its bottom dead centre position. Furthermore, a method and an apparatus shall be shown according to which initially a design position of the ram in the bottom or the top dead centre position is set, and thereafter in operation of the punch press the actual position of the ram in the bottom or top dead centre position continuously measured and compared with the corresponding design position and to adjust the height position of the ram in case of a deviation of a respective actual position from the corresponding design position in such a manner that it again attains the respective design position in the bottom and top, respectively, dead centre position.

The advantages gained by the invention are substantially to be seen in that the position of the ram which has changed due to dynamic and thermal influences can also be measured at the top dead centre position of the ram in order to correct the bottom dead centre position. Via the dynamically caused changes of the top dead centre position, it is possible to correct the height position of the ram taking the various accelerations of the ram (ratio of rods or linkages at the crank drive) and by paying attention to the inversed plus or minus sign (when measuring at the top dead centre position!) in such a manner that it remains constant relative to the lower dead centre position within said limits such as is the case with a measuring and controlling, respectively, at the lower dead centre position without any fixed abutment stops in the tool. The changes of the position of the ram occurring after an extended period of time due to thermal influences have similar effects when punching with fixed abutment stops as the dynamically caused changes. These changes can be controlled and corrected directly, independent of their being measured in the top or the bottom



dead centre. By means of the invention there accordingly is the possibility to measure the actual position of the ram during operation of the punch press selectively at that location where it depending from the application, the tool, etc. brings the most precise results.

The invention will be explained hereinafter based on drawings illustrating merely one embodiment.

Figure 1 illustrates schematically a top view of a punch press with a control device and an adjusting device for adjusting the height position of the ram, and

Figure 2 illustrates a section along the line II-II of figure 1.

In the schematic illustration of figure 1, the punch press is identified generally by the reference numeral 1. Furthermore, the ram 2 is illustrated which is pivotally mounted via pivot pins 14 to rods 16 which in turn are drivingly connected to a not illustrated crankshaft, eccentric shaft or other corresponding drive. Quite obviously, these mentioned structural members are to be considered only as one example of the drive for the ram 2.

An upper tool part 3 is mounted to the ram 2, which upper tool part 3 co-operates with a lower tool part 4, for instance with a cutting plate.

The height position of the ram 2 is adjustable during operation of the high-speed punch press, to which end a schematically illustrated adjusting motor 9 is present which acts via an arrangement of a transmission gearing 10 onto the ram 2. The transmitter of the ram height adjusting is illustrated with reference numeral 11. The cutting tools 8 are set into the upper tool part 3. These mentioned structural members are known as such, but are, however, to be considered as an example only, because a large variety of designs for adjusting the height position of the ram 2 are known to the person skilled in the art.

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According to the schematic illustration of figure 1, fixed abutment stops 5, 5A are arranged in the upper tool part 3. Further fixed abutment stops 6, 6A, 6B, 6C (see figure 2) are arranged in the lower tool part. It must hereby be noted that this illustration is to be considered as an example only. Basically one fixed abutment stop is needed on one of the two tool parts, specifically usually in the lower tool part 4. Depending from the respective tool part, it is also possible to have a plurality of fixed abutment stops or in case of multiple press tools, it is possible that at least one fixed abutment stop is present at one single working station. In case of more simple tools by means of which only a cutting is made, no fixed abutment stops may be necessary.

A rod-shaped member 7 is rigidly connected to the ram 2. This rod-shaped member 7 is designed in such a manner that it includes, in precise distances along its longitudinal extent, distributively arranged alternating magnet poles, i.e. alternating North-South-Pole arrangements. The rod-shaped member 7 can thereby be magnetised itself in this manner or may comprise a correspondingly alternatingly poled metal band.

The member 7, which moves upwards and downwards together with the ram 2, projects through a stationary mounted detector head 12 which includes at least one coil. It is accordingly obvious that when a relative movement takes place between the rod-shaped member 7 and the detector head 12, an alternating current is induced in its at least one coil, which is now fed as a signal to a programmable electronic control unit 13, which at the output is connected to the positioning motor 9 of the positioning transducer 11. The described arrangement of rod-shaped member 7, detector head 12 and control unit 13, as such generally is known and corresponding apparatuses are available on the market such that a detailed description thereof is not needed.



In the present embodiment, the rod-shaped member 7, which can also be termed ruler, and the detector head 12 are located at an inner edge area of the tool receiving space of the punch press, such as specifically illustrated in figure 2, thus close to a guide column 15 of the ram 2. At this position the measuring device, i.e. the structural members 7, 12 are located at a location having the smallest distance from the centre of the tool, whereby, however, the available space for mounting tools is not occupied.

The measuring values produced in the detector head 12 are fed as signal values via the line 17 into the control unit 13 which is of a generally known design, and in which the actual values fed thereto through the line 17 are compared with the set values. Based on the result of this comparing, the control unit 13 feeds adjusting control signals via the line 18 to the adjusting motor 9 and via line 19 to the position transmitter for adjusting the height position of the ram 2.

For the operation of the punch press, it is now possible to initially set a design position of the ram, e.g. bottom dead centre position if e.g. no fixed abutment stops are present and the corresponding value detected by the detector head 12 at the rod-shaped member 7 be stored in the control unit 13. Thereafter, the actual value of the corresponding position of the ram 2 is sensed when the punch press is in operation and compared to the design value, and in case of the actual value deviating from the design value a corresponding correction of the height position of the ram made.

In accordance with the invention, however, the top dead centre position of the ram can be selected as design value relative to the bottom dead centre position of the ram 2 for an initial setting of its position and for an adjusting of the position during operation. It has been recognized that a change of the bottom dead centre position of the ram 2, e.g. due to varying numbers of



strokes or temperatures, lead also to a change of the top dead centre position, however with changed plus and minus signs. This means that if during operation the bottom dead centre position of the ram 2 shifts downwards, the top dead centre position of the ram 2 will shift upwards. This upper dead centre position can now also be detected and scanned, and it is possible to carry out in the control unit 13 by inversely programmed plus or minus signs a corresponding correction of the bottom dead centre position. This means that it is absolutely unnecessary to scan or detect, respectively, the lower dead centre position in order to correct or adjust, respectively, this lower dead centre position, i.e. to measure a distance between e.g. the two tools in relation to the bottom dead centre position. It suffices to detect the upper dead centre position.

By means of the invention, the operator of the punch press is fully free to use, depending from a specific tool mounted, the bottom or the top dead centre position of the ram for a controlling of the lower dead centre position which is decisive for the precision of its production as design value.





Patent Claims

1. A method of measuring and controlling the
5 height position of the ram (2) of a high speed punch
press having a lower tool (4) and an upper tool (3) which
is movable relative to the lower tool and is mounted to
the ram (2) for a cutting, punching, bending and/or em-
bossing working of a web-shaped raw material, which ram
10 (2) moves in operation of the punch press between a bot-
tom dead centre position and a top dead centre position,
characterized in that initially a design position of the
ram (2) is set in the bottom or the top dead centre posi-
tion and thereafter, in operation of the punch press, the
15 actual position of the ram (2) is continuously measured
in the bottom or top dead centre position and compared
with the corresponding design position, and that in case
of a deviation of a respective actual position from the
corresponding design position the height position of the
20 ram (2) is changed in such a manner that it attains again
the respective design position in the bottom or top, re-
spectively, dead centre position.

2. An apparatus for practising the method of
claim 1, whereby the punch press includes an adjusting
25 device (9) for a changing of the height position of the
ram (2) during operation, which adjusting device (9) is
controlled by a control apparatus (7, 12, 13), character-
ized in that the control apparatus (7, 12, 13) includes a
control unit (13) and a unit (7, 12) for sensing the po-
30 sition of the ram and having a first member (7) fixedly
mounted to the ram (2), and a second stationary member
(12) co-operating with the first member (7), which mem-
bers are, therefore, movable relative to each other,
whereby one (12) of the two members (7, 12) is designed
35 to transmit to the control unit (13) a signal indicative
of the relative position between these two members (7,
12).





3. The apparatus of claim 2, characterized in that the first member (7) which is fixedly mounted to the ram (2) is of a rod or web-shaped design, and has a scale marking which is recognizable by the second, stationary member (12), by means of which scale marking the emitting of a signal indicative of the relative position between the two members (7, 12) can be induced in the second member.

4. The apparatus of claim 3, characterized in that the scale marking is formed by a plurality of North-South-Pole areas alternating in the longitudinal direction of the first member (7), and in that the second member (12) is designed as a scanning head having at least one induction loop.

5. The apparatus of claim 3, whereby the punch press includes a space for the mounting of its tools, which space is defined by guide columns (15), characterized in that the first (7) and the second member (12) of the unit (7, 12) for sensing the position of the ram are located at an inner corner area of the space for mounting the tools.

6. A method of measuring and controlling the height position of the ram (2) of a high-speed punch press having a lower tool (4) and an upper tool (3) which is movable relative to the lower tool and is mounted to the ram (2), for a cutting, punching, bending and/or embossing working of a web-shaped raw material, which ram moves in operation of the punch press between a bottom dead centre position and a top dead centre position, characterized in that initially a design position of the ram (2) is set in the bottom or the top dead centre position and thereafter, in operation of the punch press, the actual position of the ram (2) is continuously measured in the top dead centre position and compared with the corresponding design position, and that in case of a deviation from the respective actual position the height position of the ram is changed in such a manner that it





again attains the respective design position in the bottom or top, respectively, dead centre position.

7. An apparatus for practising the method of claim 6, whereby the punch press includes an adjusting
5 device (9) for a changing of the height position of the ram (2) during operation, which adjusting device (9) is controlled by a control apparatus (7, 12, 13), characterized in that the control apparatus (7, 12, 13) includes a control unit (13) and a unit (7, 12) for sensing
10 the position of the ram and having a first member (7) fixedly mounted to the ram (2) and a second stationary member (12) co-operating with the first member (7), which members (7, 12) are, therefore, movable relative to each other, whereby one (12) of the two members (7, 12) is designed to transmit to the control unit (13) a signal indicative of the relative position between these two members (7, 12).

8. The apparatus of claim 7, characterized in that the first member (7) which is fixedly mounted to the
20 ram (2) is of a rod or web-shaped design and has a scale marking which is recognizable by the second, stationary member (12), by means of which scale marking the emitting of a signal indicative of the relative position between the two members (7, 12) can be induced in the second member (12).

9. The apparatus of claim 7, characterized in that the scale marking is formed by a plurality of North-South-Pole areas alternating in the longitudinal direction of the first member (7), and in that the second member (12) is designed as a scanning head having at least
30 one induction loop.

10. The apparatus of claim 7, whereby the punch press includes a space for the mounting of its tools, which space is defined by guide columns (15),
35 characterized in that the first (7) and the second member (12) of the unit (7, 12) for sensing the position of the



ram are located at an inner corner area of the space for mounting the tools.

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