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A punch press having a toggle joint mechanism drive

The present invention relates to a punch press having a frame, at least one ram, a working space, which working space is adapted to receive a web to be processed which web is fed through the working space in a set direction of feed along a web feeding plane defined in the working space, a driving mechanism, a arrangement of toggle joint mechanism units, which toggle joint mechanism units are coupled to the driving mechanism, and are arranged at both sides of the driving mechanism in relation to the direction of feed of a web.

The modern punch technique develops the longer the more to a complete processing of a raw material, that is a complete non-cutting production of a product. This means that a punch press is designed to be a complete production center. Aside of the common cutting and shaping (bending) operations the longer the more mounting and assembling operations are made in punch presses, weldings are performed, parts are bolted together and, furthermore, threads are shaped. After every working step made on a web to be processed the web is fed further in the punch press by a set distance. Furthermore, the longer the more measuring devices are used for ensuring a good quality during the continuous working process. This leads to the fact that the lengths of the so called space for the receipt of tools, that is the punching space, is growing the longer the more individual processing steps are made in one punch press. Accordingly, longer and longer spaces for receipt of the tools are needed.

In order now to arrive at a longer space for receipt of the tools it basically would merely be necessary to scale up a given design of a punch press. However the allowable rated loading will in such case grow in the

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power of two and the masses of such scaled up punch press in the power of three.

However, in practical applications higher rated loadings are hardly needed when designing longer spaces for the receipt of tools. The extreme increase of the masses and specifically of the moving masses is even undesired.

Accordingly, a scaled up increasing of the dimensions of a punch press in order to obtain a longer space for mounting the tools leads to an extremely high financial price of such punch press, to lower rotational speeds, to a larger demand of energy and inferiorely controllable dynamic mass forces, specifically in case of the producing and working of fine and extremely precise products.

Hence, it is a general object of the present invention to provide an improved construction of a punch press in which the transmittal of forced proceeds via toggle joint mechanism units, which punch press has a long space for receipt of tools but at the same time allows high rotational speeds and does not give rise to a higher energy consumption and does not cause overly high dynamic mass forces.

A further object of the invention is to provide a punch press which comprises at least two toggle joint mechanism units located at the same side of the driving mechanism whereby all toggle joint mechanism units of the punch press are drivingly connected to at least one ram.

The present invention will better understood and objects other than those set forth above will become apparent when consideration is given to the following detail description thereof. Such description makes reference to the annexed drawings wherein:

Fig. 1 is a section through a punch press,

Fig. 2 is a section along line II-II of Fig. 1,

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Fig. 3 illustrates on an enlarged scale a detail of Fig. 1,

Fig. 4 is a section along line IV-IV of Fig. 3, and

Fig. 5 is a section along line V-V of Fig. 1.

The embodiment of the invention described hereinbelow encompasses a punch press which is driven by a electromotor and via a coupling-breaking device which is connected to an eccentric shaft. Embodiments are foreseen, however, which include for instance a crank shaft, hydraulic drives, drives having cams, etc.

The punch press of the illustrated embodiment includes a eccentric shaft 1. This eccentric shaft 1 is driven by a driving motor 51 via a belt drive 52 and a coupling-breaking device 2. Such coupling-breaking devices for punch presses are generally known such that a detailed description thereof is not needed. Figure 5 illustrates on a exemplary basks only the breaking disc 51 and the break linings 49, 50 of the coupling-breaking device 2.

The eccentric shaft 1 includes eccentric sections 3, 4a and 4b. A connecting rod 6 is supported on the eccentric section 3 and a forked connecting rod 5 is supported on the eccentric sections 4a, 4b. Bushings which can be rotated relative to each other in order to adjust the stroke of the ram of the punch press may be arranged around the eccentric sections 3, 4a and 4b in accordance with designs of a variety of known punch presses.

The connecting rod 5 is pivotally mounted via a pivot pin 7 to a connecting lever 9a, 9b and connecting rod 6 is pivotally mounted via a pivot pin 8 to a connecting lever 10a, 10b.

The connecting lever 9a, 9b is pivotally mounted via a first bolt 11 to first levers 15a, 15b of a toggle joint mechanism unit. Furthermore, the connecting

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lever 9a, 9b is pivotally mounted via a second bolt 12 to second levers 16a, 16b of a toggle joint mechanism unit. The connecting lever 10a, 10b is pivotally mounted via a third bolt 13 to levers 17a, 17b of a further toggle joint mechanism unit. Finally, the connecting lever 10a, 10b is pivotally mounted via a forth bolt 14 to levers 18a, 18b of a force toggle joint mechanism unit.

The respective upper levers 15a, 16a, 17a and 18a of the respective toggle joint mechanism units are supported via eccentric shafts 19, 20, 21 and 22, respectively, at the frame 23 of the punch press.

The respective lower levers 15b, 16b, 17b and 18b are pivotally mounted via bolts 24, 25, 26 and 27, respectively, to pressure columns 28, 29, 30 and 31, respectively. The bolts 24, 25, 26 and 27 are supported at their end portions, figure 2 illustrates as example the end portions 25a, 25b, on sliders which are illustrated generally in figure 1 by the reference numerals 32, 33, 34 and 35, respectively, and in figure 3 generally by the reference numerals 32, 33. In the sectional view of figure 2 the respective two sliders of one bolt are illustrated, that is the sliders 33, 33a at the two ends of the bolt 25. The sliders 32, 33, 34 and 35 are supported at the frame 23 in grooves which are identified in figure 3 generally by the reference numerals 36 and 53 and correspondingly in the sectional view of figure 2 by 36a and 36b.

Reverting again to the upper levers 15a, 16a, 17a and 18a of the toggle joint mechanism units it has been mentioned above that they are supported via eccentric shafts 19, 20, 21 and 22 at the frame 23. These eccentric shafts 19, 20, 21 and 22 are mounted to worm-gears 37, 38, 39 and 40. The worm-gears 37, 38, 39 and 40 mesh with worms 45, 46, 47 and 48, respectively. In the illustrated embodiment the worms 45 and 46 are connected via a drive shaft 43 to a servomotor 42 and the worms 47

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and 48 are connected via a drive shaft 44 to a servomotor 41.

The pressing columns 28 and 29 which are mounted to the lower levers 15b and 16b of the toggle joint mechanism units are connected via bolts 54 and 55 to a ram 56 and the pressure columns 30 and 31 are connected to a ram 57.

Alternatively all four pressing columns 28, 29, 30 and 31 could be connected to one single ram or each pressing column could be mounted to just one single ram, such that four rams would be present.

Now, the arrangement of the guides of the pressing columns will be described whereby attention is drawn specifically to figures 3 and 4.

The ram 56 is firmly mounted to two guiding columns 58, 59 which project downwards. The guiding columns 58, 59 are guided in the web feeding plane 60 in guides 61, 62. The ram 57 is rigidly mounted to guiding columns 63, 64 and guided in guides 65, 66. This design of guides is disclosed in detail in the Swiss patent specification CH-A-568,848 and in the US-PS-3,998,498 which disclosures are to be considered to be incorporated herein by reference thereto.

The rams 56, 57 include additionally a further, thus third guide 67 and 68, respectively which guides are located above the web feeding plane 60. Further guide columns 69, 70 which are firmly mounted to the frame 23 of the press project into these third guides 67 and 68, respectively. The guides 67, 68 comprise sliding surfaces 71 (Fig. 4) (see above mentioned documents) which extend in the longitudinal direction of the punch press, i.e. in the direction of the feed of a web. Accordingly, this guides 67, 68 prevent a pivoting of the rams 56, 57 in a direction laterally of the punch press, allow, however, due to the sliding surfaces 71 a thermal expansion of the rams 56, 57 without causing a jamming at the ram guides of the rams 56, 57.

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The lower tool mounting plate of the punch press is identified in the figures by the reference numeral 72 and its base plate by the reference numeral 73.

In case of a force F (Fig. 3) occurring during a punching operation which is a off-center force relative to the longitudinal direction of the punch press or seen the direction of the feed of a web and acting e.g. between the ram 56 and the lower tool mounting plate 72 or base plate 73, respectively, the pressing columns 28, 29 are differently elasticly deformed relative to each other. The ram 56 moves into an oblique position such as identified by the line S in figure 3 whereby the (exaggeratedly illustrated) oblique position of the ram 56 is illustrated by the broken line T. The elastic deformation and the change of the position of the pressing column 29 is illustrated by the broken line U and correspondingly of the pressing column 28 by the broken line V. Furthermore, the oblique position of the guiding column 58 is illustrated by the broken line W.

Because now the guides 61, 62 are located at the plane 60 of feed of a web the pivot point K of the ram 56 remains at the plane 60 of the feed of a web. This results in the fact, that the ram 56 and the tool 74 (upper tool) connected thereto do not pivot in the plane 60 of the feed of a web.

The guide 67, e.g. its sliding surfaces 71 (Fig. 4) allow a corresponding shifting. The seals 75, 76 between the frame 23 of the press and the pressing columns 28, 29 are movable seals which prevent also in case of an oblique position of the ram 56 a flowing of lubricant out of the closed frame 23 of the punch press intc the working space and soiling the web to be worked upon and the tools.

Above, the behavior of the various structural members has been described in case of a off-center loading of the ram 56. The same behavior of the corresponding

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structural members occurs in case of a off center loading of the ram 57.

The ram 56 is coupled via the pressure columns 28, 29 and the levers 15a, 15b and 16a, 16b, respectively, of the toggle joint mechanism units to the eccentric shafts 19 and 20, which such as described above, are coupled in turn to a common drive, the servomotor 42. The ram 57 is correspondingly coupled via the pressure columns 30, 31 and the levers 17a, 17b and 18a, 18b, respectively, of the toggle joint mechanism units to the eccentric shafts 21 and 20, which in turn are connected to the servomotor 41. It, thus, can be seen that the height positions of the two rams 56 and 57 can be set or adjusted, respectively, independently for each other. Obviously, the servomotors can also be operated in synchronism such that the height position of the rams 56 and 57 can also be adjusted in synchronism.

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Patent claims

1. A punch press having a frame (23), at least one ram (56; 57), a working space, which working space is adapted to receive a web to be processed which web is fed through the working space in a set direction of feed along a web feeding plane (60) defined in the working space, a driving mechanism (5, 6), a arrangement of toggle joint mechanism units (15a,15b; 16a,16b; 17a, 17b; 18a,18b), which toggle joint mechanism units are coupled to the driving mechanism (5, 6), and are arranged at both sides of the driving mechanism (5, 6) in relation to the direction of feed of a web; characterized in that the punch press comprises at least two toggle joint mechanism units located at the same side of the driving mechanism, whereby all toggle joint mechanism units of the punch press are drivingly connected to at least one ram.

2. The punch press of claim 1, characterized in that said at least two toggle joint mechanism units (15a,15b; 16a,16b; 17a, 17b; 18a,18b) are arranged in succession in relation to the direction of feed of a web.

3. The punch press of claim 1 or 2, in which at least two toggle joint mechanism units (15a,15b; 16a, 16b; 17a, 17b; 18a,18b) are arranged in succession in relation to the direction of feed of a web at either side of the driving mechanism (5, 6).

4. The punch press of one of the preceeding claims, in which any two toggle joint mechanism units (15a,15b; 16a,16b; 17a, 17b; 18a,18b) located at one side of the driving mechanism (5, 6) are connected to the driving mechanism (5, 6) by a connecting link unit (9a,9b; 10a,10b) common to all.

5. The punch press of one of the preceeding claims, characterized in that every toggle joint mechanism (15a,15b; 16a,16b; 17a, 17b; 18a,18b) unit includes

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first levers (15a,16a,17a,18a,) and second levers (15b,16b,17b,18b), which second levers (15a,15b; 16a,16b; 17a, 17b; 18a,18b) are pivotally mounted to the first levers (15a,16a,17a,18a) and which first levers (15a,16a,17a,18a) are coupled via eccentric shafts (19, 20,21,22) to drives (37,42,43,45; 38,42,43,46; 39,41,44, 47; 40,41,44,48) adapted to rotate said eccentric shafts (19,20,21,22) and thus adjust the height position of a respective ram (56; 57), and which second levers (15b, 16b,17b,18b) are pivotally mounted to one end of a pressing column (28,29,30,31) which is pivotally mounted at its opposite end to a respective ram (56, 57).

6. The punch press of one of the preceeding claims, characterized in that each second lever (15b,16b, 17b,18b) is pivotally mounted to the pressing column (28,29,30,31) by a pivot pin (24,25,26,27), which pivot pin (24,25,26,27) is guided at the frame (23) to be moveable in direction of the stroke of the ram (56, 57) and to be unmoveable in a direction laterally relative to the direction of the stroke of the ram (56, 57).

7. The punch press of one of the preceeding claims, characterized in that two toggle joint mechanism units (15a,15b; 16a,16b; 17a, 17b; 18a,18b) are located at either side of the driving mechanism (5, 6), whereby each toggle joint mechanism is pivotally mounted to one pressing column (28,29,30,31), so that the punch press includes four pressing columns (28,29,30,31).

8. The punch press of one of the preceeding claims, characterized in that two toggle joint mechanism units (15a,15b; 16a,16b; 17a, 17b; 18a,18b) are located at either side of the driving mechanism (5, 6), which are pivotally coupled via their respective pressing columns (28,29,30,31) to one ram (56, 57) so that the punch press includes two rams (56, 57) located at a distance from each other seen in the direction of feed of a web.

9. The punch press of one of the preceeding claims, characterized in that the eccentric shafts (19,



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20) of the toggle joint mechanism units (15a,15b; 16a, 16b) located at one side of the driving mechanism (5, 6) are coupled to a first drive (42,43) and the eccentric shafts (21,22) of the toggle joint mechanism units (17a,17b; 18a,18b) located at the other side of the driving mechanism (5, 6) are coupled to a second drive (41, 44), so that the eccentric shafts (19,20; 21,22) and accordingly the rams (56, 57) may be synchronously or separately adjusted regarding their position of height.

10. The punch press of one of the preceeding claims, characterized in that each ram (56, 57) includes at one end area two guiding columns (58,59; 63,64) located at a distance from each other, which guiding columns are mounted to the frame (23) and are guided at the web feeding plane (60).

11. The punch press of one of the preceeding claims, characterized in that at the area of each ram (56, 57) one further guiding column (69, 70) is located at a distance from the first named two guiding columns (58,59; 63,64), which further guiding columns (69, 70) are rigidly mounted to the frame (23) of the punch press and project into further guiding units (67,68) which are located in the rams (56,57), which further guiding units (67,68) are located above the plane (60) of feed of a web, so that each ram (56, 57) is guided at three locations.

12. The punch press of one of the preceeding claims, characterized in that the driving mechanism (5, 6) includes two connecting rods (5, 6) projecting from a driving unit (1, 2) in opposite directions from each other and driven from the driving unit (1, 2) in opposite senses, which connecting rods (5, 6) are drivingly connected to the toggle joint units (15a,15b; 16a,16b; 17a, 17b; 18a,18b) by respective connecting levers (9a,9b; 10a,10b).



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