

The present invention relates to an apparatus for the balancing of mass forces in a machine having a crankshaft drive with rods, specifically a punching machine having balancing weights located at both sides of the crankshaft drive, in which machine first rods are pivotally mounted to one end of single arm levers, of which the respective other ends are pivotally supported at the machine frame and which include each an intermediate bearing which is pivotally mounted via pressing rods to the punch of the machine, which balancing weights for balancing the oscillating and the component of the rotating mass forces directed in the direction of the stroke of the machine are pivotally mounted at one end to reversing levers pivotally mounted to the machine frame which in turn at their respective opposite ends are pivotally mounted to second rods driving same. Such a machine is disclosed in the DE-A-2 534 626.

The oscillating balancing weights of known such punching machines are usually pivotally mounted via one or a plurality of link rods to a structural member of the machine, which act between the crankshaft drive and the ram and correspondingly transmit operational forces and movements thereunto. The mentioned link rods can be designed for instance as reversing levers pivotally mounted at the machine frame, which reverse the direction of the movement of a structural member transmitting forces and movements at their pivotal point for a balancing oscillating of the balancing weights. Quite obviously, mass forces and oscillations occur in all structural members which are allocated to the balancing of mass forces in a respective machine, which are transmitted by the mentioned drive structure directly onto the member transmitting the forces and movements and accordingly also onto the ram of the machine. Such influences, however, detrimentally the moving sequence of the ram with regard to the cutting or embossing process, such

that the quality of a product shaped by the punching press may be influenced detrimentally.

Here the invention intends to provide a remedy. The invention as characterized in the claims solves
5 the object to provide a mass forces balancing apparatus in a machine having a crankshaft drive, specifically a punching machine in which the balancing weights are supported via link rods and reversing levers exclusively at the machine frame and the eccentric sleeve.

10 The advantage gained by the invention can be seen substantially in that the mass forces and oscillations of the balancing weights and of the structural members of the apparatus driving same are not transmitted onto the ram.

15 In the following the invention will be explained more in detail based on drawings illustrating merely one embodiment.

There is shown in:

20 Figure 1 a longitudinal section of a punching machine having a mass forces balancing apparatus structured in accordance with the invention,

Figure 2 a section along line II-II of Figure 1,

25 Figure 3 a section along line III-III of Figure 1, designed on an enlarged scale,

Figure 4 a section along line IV-IV of Figure 1, designed on an enlarged scale, and

Figure 5 a detailed view of the parallel guiding of the journal pin.

30 The crankshaft 14 of the punch press illustrated in Figures 1 and 2 is supported at both ends in the machine frame 23. This crankshaft 14 is driven, for instance, by a known coupling-/brake apparatus, of which in Fig. 2 on a purely exemplary basis a brake disk 40 and
35 the casing 41 surrounding this apparatus is illustrated, in which possibly also the flywheel and the coupling of the punch press are located. An eccentric 15 is arranged

on the crankshaft 14, such as illustrated specifically in Fig. 1, and which is surrounded by the generally known eccentric sleeve 16 used for adjusting the stroke of the machine. This eccentric sleeve 16 supports rods for the drive of the ram 34 which are termed hereinafter as first rods 1, 2. These first rods 1, 2 transmit their movement via a parallel guided journal pin 17, which will be explained in detail later on, onto single arm lever pairs 18, 19. These single arm levers 18, 19 are supported at their ends remote from the journal pin 17 via threaded spindles 22 on the machine frame 23, which threaded spindles 22 are illustrated in Fig. 4 in section. Spindle nuts 21 having bolts 21' are screwed onto these threaded spindles 22. The bearing bolts 21' project between bearing segments 44 in the respective levers 18, 19 in such a manner, that these levers 18, 19 are supported at these ends pivotally and longitudinally movable relative to the threaded spindles 22. The projections 22' of the spindle nut 21 illustrated in Fig. 4 project between projections 23' of the machine frame 23, such that the spindle nut 21 is guided against a rotating on the threaded spindle 22 and is longitudinally movable in the direction of the height of the machine. These threaded spindles 22 can be rotated in a known way by means of synchronously driven worm gearings 42, 43, wherewith the spindle nuts 21 are moved linearly. Depending on the adjusted location of these spindle nuts 21 the position of the ram 34 relative to the tool clamping plate 38 is adjusted.

At a location between the journal pins 17 and the point of support of the levers 18, 19 at the threaded spindles 22 the pressing rods 20 are pivotally mounted to mentioned levers 18, 19 via bearing bolts 20'. At the opposite end these pressing rods 20 are pivotally mounted via journals 33 to the ram 34. This ram 34, i.e. the interstice between same and the tool clamping plate 38, is accessible between the supporting columns 36 of the machine frame 23, which supporting columns 36 connect the

upper frame part of the machine with the lower frame part 39 of the machine.

The ram includes guide columns 35, which are guided in guides 37 of the machine frame, such that the
5 ram 34 is guided in its horizontal plane.

By means of the above mentioned pivotal points of the single arm levers 18, 19 the vertical movement of the first rods 1, 2 is transmitted decreased to the ram 34 in accordance with the leverage at the levers
10 18, 19.

The parallel guiding of the journal pin 17 does not proceed in a sliding guide structure, but rather by an apparatus illustrated in Fig. 5 on an enlarged scale and which is also illustrated in Figs. 1, 2 and in
15 Fig. 4. A respective reversing lever 25 is placed at both ends of the journal pin 17. It is mounted at its diametrically opposite end via pins 26 to link rods 27, 28. These link rods 27, 28 are in turn pivotally supported on bolts 29 which are supported stationary in the machine
20 frame 23.

In Fig. 5 the center position of these structural members is illustrated. Hereby ZA identifies the center position of the longitudinal axis of the journal pin 17 and the pivot axis of the link rods 27, 28 pivotally mounted to the reversing lever 25 are identified
25 in Fig. 5 at the top and at the bottom, as well, by A. If now an upwards directed movement occurs along the straight line X, the two points A of the pivotal points of the pins 26 move along a section of a circular line upwards into the position C. Hereby the longitudinal axis
30 ZA moves into the position ZC. During the oppositely directed downwards movement the points A move into the positions B and the longitudinal axis ZA moves into the position ZB. By means of such an at least substantially
35 parallel shifting of the center point Z of the journal pin 17 over the entire range of the stroke of the punch press is secured.

Returning to Fig. 1, the drive of the balancing weights 10, 11 will be explained hereinafter. Second rods 3, 4 are supported on the eccentric sleeve 16. The first rods 1, 2 are hereby of a forked design such as illustrated in Fig. 2 and the second rods 3, 4 project between the legs of the fork of the first rods and are supported on the eccentric sleeve 16, which accordingly supports together all four rods 1-4. The second rods 3, 4 extend upwards towards the cover 24 of the machine frame and are pivotally mounted via bolts 12, 13 to a respective reversing lever 5, 6, which reversing levers 5, 6 are illustrated in a horizontal section in Fig. 3. The two reversing levers 5, 6 are supported at the machine frame 23 via shafts 7, 8. The end of the reversing levers 5, 6 remote from the bolts 12, 13 is pivotally mounted via respective bolts 9 to the balancing weights 10, 11. It is now obvious, that the above described structural members cause a movement of the balancing weights 10, 11, which balance the oscillating mass forces (directed vertically).

Link rods 30 are hingedly mounted to the opposite end of the balancing weights 10, 11 via bolts 32. These link rods 30 are in turn pivotally mounted at their opposite ends via a respective bolt 31 (see also Fig. 2) to the first rods 1, 2. It is to be noted, that accordingly the link rods 30 are pivotally mounted to the respective first rods 1, 2 at a location that is located relative to the pivotal point (journal pin 17) of the single arm levers 18, 19 opposite of the crankshaft 14, to which end these first rods 1, 2 include an extension extending beyond the point of support of the journal pin 17. Accordingly, the lateral movements of the rotating masses of the eccentric 15 and eccentric sleeve 16 as well as the lateral movement of the corresponding mass portions of the rods 1-4 are balanced by the reverse movement due to the laterally horizontal moving of the balancing weights 10, 11.

Because the balancing weights 10, 11 as well as the structural members mounted thereto or drivingly connected thereto, respectively, are at no place connected to structural members which transmit forces and movements directly onto the ram 34, e.g. no longer to the single arm levers 18, 19, the oscillations and mass forces which would influence the design dimensions and quality of the product produced are kept away from the ram 34.



Patent claims

5 1. Apparatus for the balancing of mass forces
in a machine having a crankshaft drive with rods, specif-
ically a punching machine having balancing weights (10,
11) located at both sides of the crankshaft drive, in
which machine first rods (1, 2) are pivotally mounted to
10 one end of single arm levers (18, 19), of which the re-
spective other ends are pivotally supported at the ma-
chine frame (23) and which include each an intermediate
bearing (20') which is pivotally mounted via pressing
rods (20) to the punch (34) of the machine, which balanc-
15 ing weights (10, 11) for balancing the oscillating and
the component of the rotating mass forces directed in the
direction of the stroke of the machine are pivotally
mounted at one end to reversing levers (5, 6) pivotally
mounted to the machine frame (23) which in turn at their
20 respective opposite ends are pivotally mounted to second
rods (3, 4) driving same, characterized in that for the
balancing of the component of the rotating mass forces
directed perpendicularly to the direction of stroke the
balancing weights (10, 11), in order to execute an oscil-
25 lating movement perpendicularly to the direction of the
stroke are pivotally mounted at the opposite end via a
respective link rod (30) to a respective first rod (1, 2)
at a point located relative to the pivotal point of the
single arm levers (18, 19) opposite of the crankshaft
30 drive of the for this reason lengthened first rods (1,
2), that each reversing lever (5, 6) is pivotally mounted
to a respective own second rod (3, 4), such that the re-
versing levers (5, 6) are driven independently of each
other, and in that all first and second rods (1-4) are
35 supported on a common eccentric sleeve of the crankshaft
drive.



2. Apparatus according to claim 1, characterized in that the first rods (1, 2) are forked at their end supported on the common eccentric sleeve (16) and the second rods (3, 4) are supported on the eccentric sleeve (16) between the legs present due to the forked structure of the first rods (1, 2).

3. Apparatus according to claim 1 or 2, characterized in that the first rods (1, 2) are supported for a parallel guiding on a journal pin (17), to which one end of the respective single arm levers (18, 19) is pivotally mounted, which journal pin (17) is supported at both sides in a respective reversing lever (25), which levers are mounted at diametrically opposite ends to respective link rods (27, 28) which at their opposite ends are pivotally supported at the machine frame, wherewith the journal pin (17) is guided at least substantially parallel within the entire stroke range of the machine.