

Multistage Press

This invention concerns a multistage press and the use of the press for the fabrication of lids for beverage cans in accordance with the preambles of the independent patent claims.

For the industrial fabrication of beverage can lids, multistage presses are predominantly used in which, in addition to the upward and downward movement of the press plunger, forming tool elements travel towards and away from said plunger. This movement is produced by the presently known multistage presses in such a way that the moveable tool elements are coupled with the plunger drive by way of crank or cam drives or by means of lever or tie rod arrangements. However, all known multistage presses have the disadvantage that they can only be driven with a relatively low number of strokes per minutes and the precision of movement declines rapidly with the increasing number of strokes.

The task is therefore to provide a multistage press which does not have the disadvantages of the state of the art or which at least partially avoids these disadvantages.

This task is solved by the multistage press according to patent claim 1.

Accordingly, a first aspect of the invention concerns a multistage press with a machine-mounted clamping plate and a press plunger located opposite the clamping plate and working against said clamping plate. Within the clamping plate, an insert is arranged that serves the purpose of receiving a tool and which is connected with driving means, e.g. with a servo motor or an universal-joint shaft driven by the press drive, in such a way that, depending on a movement of the press plunger, it is alternately moveable in the direction towards the press plunger and away from it. The insert and the drive means are positively connected with each other in both directions of movement, which is accomplished by coupling means arranged between them that convert the revolving rotational drive movement of the driving means into the upward and downward movement of the insert by tracing, at a revolving rotating structural component of the coupling means, the shape of at least one revolving guiding surface with shape tracing means.

Separate shape tracing means are provided for both directions of movement, thus for the upward as well as for the downward movement. By this it is possible to provide multistage presses which can be operated with a high number of strokes and which, at the same time, provide an excellent precision of movement.

In a preferred embodiment of the multistage press, the shape tracing means for both movement directions are prestressed against each other so that they trace the shape of the at least one guiding surface under prestress. By this it becomes possible to carry out the conversion of the rotary drive movement into the upward and downward movement in a play-free manner, through which the precision can further be increased.

In case for each of the two movement directions a separate guiding surface is provided, which is preferred, it becomes possible to also realise asymmetrical movement sequences of the insert.

By advantage, for the tracing of the movement for the movement direction of the insert towards the press plunger, more shape tracing means are provided than for the tracing for the movement direction of same away from the press plunger because, in this way, the first-mentioned movement, in which typically deformation or cutting work is performed, can take place under significantly higher load than the latter-mentioned movement.

In a further preferred embodiment of the multistage press, the at least one guiding surface is formed by a cam or a cam disk, wherein it is additionally preferred that the shape tracing means are designed as shape tracing rollers. In this way, major forces can be transmitted in a simple manner.

It is a further advantage in this case if the shape tracing rollers for both movement directions are mounted in a common structural element because, in this way, additional clearances are avoided and it is moreover possible in an easy manner to prestress the shape tracing rollers of the two movement directions against each other, for example by coupling their bearing locations together by means of straining screws.

If at such a multistage press the shape tracing rollers are mounted in a common lever, namely preferably in the area of one end of the lever, wherein the lever is mounted in the press frame and is connected with the insert in such a way that a force provided by one of the shape tracing rollers is transmitted to the insert with a transmission ratio of greater than one, very large lifting forces can be provided at the insert.

Preferably, the position of the bearing of the common lever in the press frame can be adjusted so that it is possible to compensate for manufacturing tolerances.

In yet a further preferred embodiment of the multistage press, the insert has a longitudinal extension in the direction of material flow of the press amounting to at least half, preferably two thirds of the longitudinal extension of the clamping plate. By this, there is the possibility of arranging several identical tools on the insert and, subsequently, to manufacture a corresponding number of products per press stroke.

Preferably, the insert is plate-shaped, preferably substantially rectangular, so that, as far as possible, it can be universally fitted with tools and, at the same time, forms a sturdy structure.

In yet a further preferred embodiment of the multistage press, the rotation axis of the structural element of the coupling means, which provides the at least one revolving guiding surface, and subsequently also the rotation axis of this guiding surface, is arranged parallel to the direction of material flow of the press, by which it becomes possible to arrange several coupling configurations with guiding surfaces and shape tracing means along one single shafting in the direction of material flow and thereby connect them play-free with one another.

At yet a further preferred embodiment, the insert is guided in a linear manner by guiding means which, at embodiments with shape tracing rollers mounted in a common lever, is by advantage accomplished in that the guiding means have at least one guide column guided in an upper and in a lower linear bearing, and the lever engages the guide column in the area between both linear bearings. A particularly sturdy structure is obtained in this way.

If the multistage press has several identical coupling means or configurations, respectively, with guiding surfaces and shape tracing means, such as for example several cam sections which, seen over the extension of the insert, are arranged at several locations, preferably at exactly two locations and by advantage in the direction of material flow of the press in successive order, and are connected with the insert, also relatively long inserts can be realised without encountering the danger of a chocking.

If all elements of the coupling means, which are required for the conversion of the rotatoric drive movement into the movement of the insert, are integrated in the machine bed, which is preferred, a compact structural design with a minimum of externally located and moving parts is obtained as a result so that the danger of injury can be reduced and, in addition, the moving parts are protected against dirt and damage.

As driving means for providing for the rotatoric drive movement for the coupling means, preferably an universal-joint shaft connected with the press drive or a servo motor is present, wherein the first-mentioned variant has the advantage of a mechanically synchronised coupling and the latter-mentioned the advantage of an uncomplicated adaptation to existing production plants.

If the universal-joint shaft or the servo motor is coupled by way of a reduction gear with the structural component providing the at least one guiding surface, the torque at the universal-joint shaft or at the servo motor is reduced, whereby the torsion stress of the participating structural components can be reduced.

A second aspect of the invention concerns the use of the multistage press in accordance with the first aspect of the invention presented above for the manufacture of lids for beverage cans. With such a use, the advantages of the invention are particularly evident.

Further preferred embodiments of the invention result from the dependent claims and from the following description based on the Figures. Therein shows:

- Fig. 1a: a front view of a first multistage press according to the invention;
- Fig. 1b: a vertical cross-section in the direction of material flow of the press through the machine bed of the press from Fig. 1a;
- Fig. 1c: a vertical cross-section through the machine bed of the press from Fig. 1a along the line A-A in Fig. 1b;
- Fig. 1d: a cross-section along the line B-B in Fig. 1c;
- Fig. 2: a cross-section as Fig. 1b through a second multistage press according to the invention; and
- Fig. 3: a cross-section as Fig. 1c through a third multistage press according to the invention.

The basic structural design of a first multistage press according to the invention is recognisable from the Figures 1a to 1d, which show a front view of the press as well as various cross-sections through the machine bed 11 of the press. As can be seen, the press has a press plunger 2 which can be intermittently moved up and down with the press drive (not shown) for performance of punching and/or deforming work with a tool (not shown) which is secured thereto. Opposite the plunger 2, a machine-mounted clamping plate 1 is arranged within which an insert plate 3 is arranged. The insert plate 3 is guided in a vertical sliding manner in the machine bed 11 by means of two guide columns 13, each of which is guided in upper and lower linear bearings 12, and can, depending on a movement of the plunger 2, be moved towards and away from it for the purpose of producing a movement superimposed on the plunger movement of tool elements (not shown) secured on the insert plate 3. Here, the driving of the insert plate 3 is effected in such a way that, by way of an universal-joint shaft 4, drive energy is made available from the press main motor which is then supplied by way of an angular reduction gear 14 and a torsion-proof metal disk coupling 19 to a cam shaft 15 running parallel to the direction of material flow D of the press, whose cams 5 move back and forth levers 9 connected with the insert 3, and by doing so, lift and lower the insert 3. The camshaft 15 is supported in the machine bed 11 in several bearings 18 designed in each case as exchangeable units, and has each two cam sections which consist in each case of two wider lifting cams 5 and a narrower lowering cam 5 arranged therebetween. The cam

track 8a of each lifting cam 5 is traced by two lifting rollers 6, whereas the cam track 8b of the lowering cam 5 is traced by one single lowering roller 7. Here, the lifting and lowering rollers 6, 7 of each cam section are mounted at one end of a lever 9 and are prestressed against each other so that they trace the shape of the cam tracks 8a, 8b under prestress. At the other end, the lever 9 is hinged by means of a shackle 16 to a machine-mounted swivel joint 10, which is arranged as a dismountable insert in the machine bed 11 and whose position can be adjusted by means of an eccentric. Between its two ends, the lever 9 is coupled with the associated guide column 13 by way of pins 17, so that the tilting movement executed by the lever 9 during the tracing of the shape of the guide tracks 8a, 8b is converted into a purely translatory up and down movement of the guide column 13 and the insert plate 3 supported by this.

Fig. 2 shows a vertical cross-section in the direction of the material flow D through the machine bed 11 of a second multistage press according to the invention, which differs from that shown in Fig. 1 essentially in that only one cam section arranged centrally in the machine bed 11 exists which has here, however, three lifting cams 5 and two lowering cams 5, wherein here as well the cam track 8a of each lifting cam 5 is traced by two lifting rollers 6 and the cam track 8b of each lowering cam 5 is traced by a single lowering roller 7.

Fig. 3 shows a vertical cross-section transverse to the direction of material flow D through the machine bed 11 of a third multistage press according to the invention, which differs from the other two models previously shown essentially in that the lifting and lowering rollers 6, 7 are mounted directly in the guide column 13 and, consequently, a lever can be dispensed with. Furthermore, for each cam section, only one single cam 5 exists, whose cam track 8 is traced by the lifting roller 6 as well as by the lowering roller 7.

Even though in the present examples exclusively rollers 6, 7 are used as shape tracing means according to the claims, also the use of other shape tracing means, such as e.g. levers with sliding surfaces, is envisaged.

Patent Claims

1. Multistage press with a machine-mounted clamping plate (1) and a press plunger (2) located opposite the clamping plate (1) and working against it, wherein within the clamping plate (1) an insert (3) is arranged which is connected with drive means (4) in such a way that it alternately can be moved in the direction towards the press plunger (2) and away from this plunger by means of the drive means (4) depending on a movement of the press plunger (2), wherein in both directions of movement there is a positive coupling to the drive means (4) and wherein, between the drive means (4) and the insert (3), coupling means (5, 6, 7) are arranged which are designed for the conversion of a revolving rotatoric drive movement of the drive means (4) into the movement of the insert (3) by tracing, at a revolving rotating structural component (5) of the coupling means, the shape of at least one revolving guiding surface (8, 8a, 8b) with shape tracing means (6, 7), characterised in that separate shape tracing means (6, 7) exist for each of the two directions of movement.
2. Multistage press according to claim 1, characterised in that the shape tracing means (6, 7) for both directions of movement are prestressed against each other in such a way that they trace the shape of the guiding surface (8, 8a, 8b) under prestress.
3. Multistage press according to one of the preceding claims, characterised in that separate guiding surfaces (8a, 8b) exist for each of the two movement directions.
4. Multistage press according to one of the preceding claims, characterised in that, for the movement direction of the insert (3) towards the press plunger (2), more shape tracing means (6) are provided than for the movement direction of the same away from the press plunger (2).

5. Multistage press according to one of the preceding claims, characterised in that the at least one guiding surface (8, 8a, 8b) is formed by a cam (5) or a cam disk.
6. Multistage press according to claim 5, characterised in that the shape tracing means (6, 7) are designed as shape tracing rollers (6, 7).
7. Multistage press according to claim 6, characterised in that the shape tracing rollers (6, 7) for both directions of movement are mounted in a common structural component (9).
8. Multistage press according to claim 7, characterised in that the shape tracing rollers (6, 7) are mounted in a common lever (9), in particular in the area of one end of the lever (9), and that the lever (9) is connected with a machine-mounted point (10) of the machine bed (11) and with the insert (3) in such a way that a force provided by the shape tracing rollers (6, 7) is transmitted to the insert (3) with a transmission ratio of greater than one.
9. Multistage press according to claim 8, characterised in that the machine-mounted point (10) is designed adjustably.
10. Multistage press according to one of the preceding claims, characterised in that the insert (3) has a longitudinal extension in the direction of material flow (D) of the press which amounts to at least one half, in particular to at least two thirds, of the extension of the clamping plate (1) in this direction (D).
11. Multistage press according to one of the preceding claims, characterised in that the insert (3) is designed in a plate-shaped manner and, in particular, that it is essentially rectangular.
12. Multistage press according to one of the preceding claims, characterised in that the rotation axis of the structural component (5) of the coupling means, which provides the at least one revolving guiding surface (8, 8a, 8b), is arranged parallel to the direction of material flow (D) of the press.

13. Multistage press according to one of the preceding claims, characterised in that the insert (3) is guided in a linear manner by guiding means (12, 13).
14. Multistage press according to claim 8 and according to claim 13, characterised in that the guiding means (12, 13) have at least one guide column (13) guided in an upper and in a lower linear bearing (12) and the lever (9) is connected with the guide column (13) in the area between the two linear bearings (12).
15. Multistage press according to one of the preceding claims, characterised in that the press has several identical coupling means (5, 6, 7) which, as seen over the extension of the insert (3), at several locations, in particular at exactly two locations, are connected with the insert (3).
16. Multistage press according to one of the preceding claims, characterised in that all elements of the coupling means (5, 6, 7), which are required for the conversion of the rotatoric drive movement into the movement of the insert (3), are integrated in the machine bed (11).
17. Multistage press according to one of the preceding claims, characterised in that, for providing the rotatoric drive movement for the coupling means (5, 6, 7), there exists an universal-joint shaft (4) connected to the press drive or a servo motor.
18. Multistage press according to claim 17, characterised in that the universal-joint shaft (4) or the servo motor is coupled by way of a reduction gear (14) with the structural component (5) providing the at least one guiding surface (8, 8a, 8b).
19. Use of the multistage press according to one of the preceding claims for the manufacture of lids for beverage cans.