

For the unmanned operation of a manufacturing plant over an extended period of time, under certain circumstances, especially in the case of rapidly changing manufacturing tasks, a large number of work-pieces and tools has to be made available, for which purpose relatively large magazine chambers and handling appliances working over correspondingly wide chambers must be available. For operating one or more processing machines, for this case frequently a plurality of multi-plane rotary-cycle stores and for example a gantry robot are necessary as the handling appliance, as is apparent for example from the article "Möglichkeiten und Trends bei der automatischen Werkstückhandhabung mit Industrierobotern" ("Possibilities and Trends in automatic work-piece handling with industrial robots") in the Journal "wt-Z.ind.Fertig. 76 (1986) No. 10, Pages 585-589 (Publisher: Springer-Verlag). According to experience, the material expenditure and the space requirement for the auxiliary devices necessary to such an extent are considerable. Furthermore, the interruption of operation for the renewal of the magazine objects undertaken at the location of the magazine, lasts for a long time according to the periphery of the magazine chamber.

In comparison therewith, the invention relates to a magazine for tools and/or work-pieces, which with a fixed location in a flexible manufacturing plant is intended for cooperation with at least one processing device and a handling appliance associated therewith for the automatic exchange of tools or work-pieces in the processing device and which comprises rotating shelving with a plurality of storage tiers arranged one above the other on a column, the rotating shelving being constructed as a separate component and being inserted in an exchangeable manner in the stationary part of the magazine containing the means for operating the rotating shelving.

In this way it is possible, at the magazine station, to provide a smaller storage volume and a simpler handling appliance for the operation of the processing machines. Due to this, the access

time to the magazine can also be reduced. The exchangeable rotating shelving may be replaced periodically or as required by shelving with new work-pieces or tools and can be unloaded and reloaded outside the magazine station. In this case this exchange may take place without interrupting the continuous production process.

A magazine of this type is described in patent specification JP-A-59 146 227. This magazine is set up for receiving several sets of transportable rotating shelving and for bringing the latter individually into the range of access of a handling appliance associated with the magazine. For this purpose the magazine comprises a rotary support device with several support arms, on the free ends of which rotating shelving provided with a support plate can be respectively deposited. Forming the stationary part of the magazine is a base, in which a driving device for rotating the support device is located. With its assistance, a support arm may respectively be brought into an operating position, in which rotating shelving deposited thereon can be connected at the lower end of its column to a drive motor likewise located in the base, in order to rotate this rotating shelving and to bring the tools placed thereon selectively into a removal position. Furthermore, a lifting device is connected to the drive motor, which serves to lift the coupled rotating shelving from the support arm for the positioning operation.

Magazines with rotating shelving, which is mounted in a frame at both ends of the rotary column, are known per se, for example from patent specifications EP 0132599 A1 and EP 0297034 A2. However, in these magazines, the rotating shelving is not exchangeable.

It is the object of the invention to improve the magazine of the aforementioned general type by avoiding the afore-described drawbacks.

The invention achieves the said object by the fact that the

stationary part of the magazine comprises a frame, on which are located releasable coupling means cooperating with the two ends of the rotary column of the rotating shelving, for the mounting and drive of the rotating shelving, that the rotary column of the rotating shelving comprises at its lower end a base plate with a centering collar open on the under side and at its upper end a centering cone, that located in the lower part of the frame is a driven swivelling bolster provided with an upwardly directed centering journal, on which swivelling bolster the rotating shelving is fitted, the base plate of the rotating shelving resting on the swivelling bolster and its centering journal engaging in the centering collar of the base plate, that mounted to rotate freely on the upper side of the frame is a shaft butt with a downwardly open conical centering bore for receiving the centering cone of the column, that the swivelling bolster together with the rotary drive is mounted on a lift table, which pushes the inserted rotary shelving upwards under the action of a force, so that its column is retained in a form-locking manner and in the correct position between the swivelling bolster and the shaft butt and the base plate is connected by frictional resistance to the swivelling bolster and that provided on the stationary part of the magazine is a conveying device with a horizontal conveying path for the exchange of the rotating shelving, the rotating shelving being able to be lowered from the operating position with the base plate onto the conveying path and at the time of release from the rotary shelving, the coupling means releasing the latter for a movement in the conveying direction.

The conveying device facilitates the exchange of the rotating shelving, i.e. the removal of the rotating shelving which is in use, from the magazine station and its replacement by the introduction of other, newly equipped rotating shelving.

The means for moving the rotary shelving from the operating position into the conveying position are constructed for example so that the lifting table can be lowered out of the operating

position so far that the centering journal on the swivelling bolster comes out of engagement with the centering collar at the lower end of the column after placing the rotating shelving on the conveying device and that the shaft butt can be withdrawn upwards in order to bring the centering cone at the upper end of the column out of engagement with the centering bore on the shaft butt, so that the release of the rotating shelving from the coupling means can take place in two phases, in the first phase the rotating shelving being placed by its base plate on the conveying device under the continuing action of the upper coupling means and the lower coupling means being released and in the subsequent second phase the upper coupling means being released from the rotating shelving.

The loading or reloading of rotating shelving removed from the magazine may be carried out at any suitable place, for example directly beside the magazine station, or, however, at a place provided specifically for this. In manner known per se, a reloading station remote from the magazine station, for loading and unloading rotary shelving as well as conveying means for conveying the rotary shelving from the reloading station to the magazine station and vice versa may be provided.

A roller conveyor with jointly driven rollers may be provided as the conveying device. Appropriately, guide members for the longitudinal guidance of the rotating shelving, which act on the periphery of the base plate are furthermore provided along the conveying path and provided at the end of the conveying path is an end stop for stopping approaching rotating shelving in the centering region.

One embodiment of the invention is illustrated in the drawings, in which:

Figure 1 is a front view of the magazine with exchangeable rotating shelving;

Figure 2 is a side view of the magazine;

Figure 3 is a plan view of the magazine;

Figure 4 is a side view of the exchangeable rotating shelving constructed as a separate component;

Figure 5 is a front view according to Figure 1, with rotating shelving lowered onto the conveying device and released from the coupling means;

Figure 6 is a sectional view of the lower coupling means to an enlarged scale, in the operating state;

Figure 7 is a sectional view according to Figure 6 of the coupling means in the released state;

Figure 8 is a sectional view of the upper coupling means, to an enlarged scale, in the operating state;

Figure 9 is a sectional view according to Figure 8 of the coupling means in the released state;

Figure 10 is a diagrammatic illustration of a simple manufacturing plant, with a processing device, a handling appliance for the automatic exchange of tools and/or work-pieces and a magazine according to the invention for the objects to be handled.

The magazine with exchangeable rotating shelving selected as the embodiment comprises a frame designated generally by the reference numeral 1 and constructed from square tubes, which frame has a square design and a height corresponding to the rotating shelving 2 illustrated separately in Figure 4 and which frame supports the stationary part of the magazine containing the means for operating the rotating shelving. The individual parts of this frame 1 will be discussed in detail as necessary in the course of the description.

According to Figure 4, the rotating shelving designated generally by the reference numeral 2 consists in known manner essentially of a rotary column 3, to which are attached for example five supports 4 for the objects to be handled (work-pieces and/or tools) in the form of round discs in several planes with regular vertical spacings. For this purpose the object supports 4 are respectively provided with a hub 5, which is anchored in a manner which is not shown, for example by pinning, to the column 3.

According to Figure 3, each object support 4 comprises on its periphery a number (for example eight) of storage locations 6 having an identical construction, which are characterised for example by a radial notch 7 and axial recesses 8 for position-correct placing of objects with uniform mounting.

At its lower end, the rotary column 3 of the rotating shelving 2 comprises a base plate 9, which can be anchored to the column 3 in a similar manner to the object supports 4 by a hub 10. This base plate 9 has a somewhat larger diameter than the object supports 4 and close to its periphery is provided with a number (for example eight) of locking holes 11, which serve for positioning the rotating shelving 2 in different rotary positions. The hub 10 located at the lower end of the column 3 simultaneously forms a centering collar 12 open on the under side and at its upper end the column 3 comprises a centering cone 13.

Coupling means mounted on the frame 1 are provided for the mounting and drive of the rotating shelving 2, which coupling means cooperate with the ends of the column 3 constructed in the manner described. Located in the lower part of the frame 1 is a swivelling bolster 14, on which the rotating shelving 2 rests in the operating position by its base plate 9 according to Figures 1 and 2. Details of this swivelling bolster 14 can be obtained from Figures 6 and 7. For the frictional connection between the rotating shelving 2 and swivelling bolster 14, a friction coating 15 is applied to the latter. The swivelling bolster 14 is seated on a shaft 16 and with the latter is mounted to rotate on a lifting table 17 in the manner illustrated. For driving the swivelling bolster 14, the latter is provided on its periphery with toothing 18, in which a pinion 19 of an electric drive motor 20 engages, which is attached to the lifting table 17. The upper end of the shaft 16 forms an upwardly projecting centering journal 21, which engages in the centering collar 12 on the base plate 9 of the fitted rotary shelving 2 (Figure 1). Provided for the vertical adjustment of the lifting table 17 are four working cylinders 22, which can be supplied with a pressure

medium and whereof the piston rods 23 are connected to the lifting table 17. The working cylinders 22 are mounted on the under side of a mounting plate 24, which in turn rests on a frame part 25 of the frame 1.

According to Figure 1, the upper coupling means consist of a rotary and vertically displaceable shaft butt 26, which is provided with a conical centering bore 27, which is open on the under side, for receiving the centering cone 13 of the column 3 of the rotating shelving 2. The shaft butt 26 is mounted in a driving block 28, which rests on a platform 29, which is in turn anchored by support plates 30 to an upper frame part 31 of the frame 1. As shown in detail in Figures 8 and 9, the drive block 28 is a diagrammatically illustrated working cylinder with a pressure-actuated piston 32, the shaft butt 26 being mounted to rotate freely in the hollow piston rod 33.

In the operating state of the magazine, the lifting table 17 is located in an upper end position (Figures 1, 2 and 6) under the action of the force of the working cylinder 22, and the working cylinder 28 which is under pressure pushes the shaft butt 26 with an opposed direction of force against the upper end 13 of the column 3. In this case, the centering journal 21 on the swivelling bolster 14 is located in engagement with the centering collar 12 on the lower end of the column 3 and the centering cone 13 at the upper end of the column 3 is located in engagement with the conical centering bore 27 of the shaft butt 26, so that the column 3 is held in a form-locking manner and in the correct position between the swivelling bolster 14 and the shaft butt 26 and the base plate 9 is connected by frictional resistance to the swivelling bolster 14.

Provided in manner known per se for fixing the rotating shelving 2 in the angular positions provided for the removal of the stored objects by a handling appliance is a vertically movable locking pin 34, which cooperates with the locking holes 11 in the base plate 9 of the rotating shelving 2 and can be actuated by a

working cylinder 36 connected to the frame 1 by way of a support arm 35 (Figure 1). Furthermore, located at the edge of the base plate 9 is an electronic memory device 37, which inter alia contains data for the identification of the rotating shelving used, which data may be read by a reading device 38 mounted on the frame 1 (Figure 2).

Provided for the exchange of the rotating shelving 2, on the stationary part of the magazine, is a conveying device 39 with a horizontal conveying path, onto which the rotating shelving 2 can be lowered. In this case the latter is a roller conveyor arranged on the base plate 24, the rollers 40 of which are mounted in plane parallel support plates 41 and are driven by way of chains 42 by a common drive motor (not shown). Provided along the conveying path are guide rails 43, acting on the periphery of the base plate 9, for the longitudinal guidance of the rotating shelving 2, which guide rails 43 are attached to a frame part 44 of the frame 1 (Figures 1 and 3). Located on the same frame part 44 is an end stop 45 (Figures 2 and 3), against which the base plate 9 strikes, when rotating shelving 2 is introduced on the conveying device 39 into the frame 1, so that the rotating shelving 2 is stopped in the centering region, in order that the centering journal 21 may enter the centering collar 12 and the centering cone may enter the conical centering bore 27.

The removal of rotating shelving 2 from the magazine takes place in such a way that first of all the rotating shelving 2 is lowered from the operating position illustrated in Figures 1 to 3 into the conveying position illustrated in Figure 5, i.e. onto the rollers 40 of the conveying device 39. In this case the lifting table 17 can be lowered so far that the centering journal 21 on the swivelling bolster 14 comes out of engagement with the centering collar 12 at the lower end of the column 3, after placing the base plate 9 on the rollers 40. In this case, the working cylinder 28 still remains under pressure, so that the guiding action at the upper end of the column is maintained during the lowering movement of the rotating shelving 2. After

this the shaft butt 26 is raised by counter pressure in the working cylinder 28 in order to bring the centering cone at the upper end of the column out of engagement with the centering bore 27 in the shaft butt 26. Thus the rotating shelving 2 is released from the lower and upper coupling means, whereof the end position is shown in Figures 7 and 9 and can be moved by the conveying device 39 on the front side of the frame 1 shown in Figure 1, out of the latter, as soon as the locking pin 34 has also been withdrawn in a downwards direction from the previously occupied locking hole 11 in the base plate 9.

In the simplest case, the rotating shelving 2 removed from the frame 1 is loaded onto a carriage (manual or driven carriage) brought up to the frame 1, whereas another rotating frame with replacement objects is brought up to the frame 1 on a further carriage and is introduced into the frame 1 by means of the conveying device 39. Appropriately carriages of this type have a rolling platform in order to facilitate the transfer and suitable means for fixing the rotating shelving to be conveyed, on the platform.

Figure 10 shows diagrammatically as an example of a simple manufacturing plant, the spatial arrangement of a processing device 50, of a handling appliance 51 and of a magazine 52 according to the invention with exchangeable rotating shelving 2 according to the construction illustrated in Figures 1 to 9 and symbolically indicated tools or work-pieces 53 mounted therein. The handling appliance 51 is equipped with three controlled spindles and comprises a gripper arm 54, which is mounted to move longitudinally in a bearing part 55. The bearing part 55 is mounted to rotate on a carriage 56 about the spindle 57, which is turn mounted to slide vertically on a stationary column 58. The various phases of movement of the gripping arm 54 when changing the tool or work-pieces are indicated by dot-dash lines. Figure 10 shows clearly that the auxiliary devices take up relatively less station space and the handling appliance 51 requires only a small space for movement. This advantage results

from the fact that even for a relatively long operation of the manufacturing plant, a single magazine 52 of the type described is sufficient and when exchanging equipment, access of the gripper arm 54 can be restricted to this one magazine 52.



Claims

1. Magazine for tools and/or work-pieces, which with a fixed located in a flexible manufacturing plant is intended for cooperation with at least one processing device and a handling appliance associated therewith for the automatic exchange of tools or work-pieces and which comprises rotating shelving (2) with a plurality of storage tiers arranged one above the other on a column (3), the rotating shelving (2) being constructed as a separate component and being inserted in an exchangeable manner in the stationary part of the magazine containing the means for operating the rotating shelving, characterised in that the stationary part of the magazine comprises a frame (1), on which are located releasable coupling means (14, 21; 26) cooperating with the two ends of the rotary column (3) of the rotating shelving (2), for the mounting and drive of the rotating shelving (2), that the rotary column (3) of the rotating shelving (2) comprises at its lower end a base plate (9) with a centering collar (12) open on the under side and at its upper end a centering cone (13), that located in the lower part of the frame (1) is a driven swivelling bolster (14) provided with an upwardly directed centering journal (21), on which swivelling bolster the rotating shelving (2) is fitted, the base plate (9) of the rotating shelving (2) resting on the swivelling bolster (14) and its centering journal (21) engaging in the centering collar (12) of the base plate (9), that mounted to rotate freely on the upper side of the frame (1) is a shaft butt (26) with a downwardly open conical centering bore (27) for receiving the centering cone (13) of the column (3), that the swivelling bolster (14) together with the rotary drive (19, 20) is mounted on a lift table (17), which pushes the inserted rotating shelving (2) upwards under the action of force, so that its column (3) is retained in a form-locking manner and in the correct position between the swivelling bolster (14) and the shaft butt (26) and the base plate (9) is connected by frictional resistance to the swivelling bolster (14) and that provided on the stationary part of the magazine is a



conveying device (39) with a horizontal conveying path for the exchange of the rotating shelving (2), the rotating shelving (2) being able to be lowered from the operating position with the base plate (9) onto the conveying path and at the time of release from the rotary shelving (2), the coupling means (14, 21; 26) releasing the latter from a movement in the conveying direction.

2. Magazine according to Claim 1, characterised in that the lifting table (17) can be lowered out of the operating position so far that the centering journal (21) on the swivelling bolster (14) comes out of engagement with the centering collar (12) at the lower end of the column after placing the rotating shelving (2) on the conveying device (39) and that the shaft butt (26) can be withdrawn upwards in order to bring the centering cone (13) at the upper end of the column out of engagement with the centering bore (27) on the shaft butt (26), so that the release of the rotating shelving (2) from the coupling means (14, 21; 26) can take place in two phases, in the first phase, the rotating shelving (2) being placed by its base plate (9) on the conveying device (39) under the continuing action of the upper coupling means (26) and the lower coupling means (14, 21) being released and in the subsequent second phase the upper coupling means (26) being released from the rotating shelving (2).

3. Magazine according to Claim 1, characterised in that guide members (43) for the longitudinal guidance of the rotating shelving (2) are provided along the conveying path and which guide members act on the periphery of the base plate (9).

4. Magazine according to Claim 1, characterised in that the conveying path comprises an end stop (45), which stops the approaching rotating shelving (2) in the respective centering region.

5. Magazine according to one of the preceding Claims, characterised in that provided as the conveying device (39) is a roller conveyor with jointly driven rollers (40).