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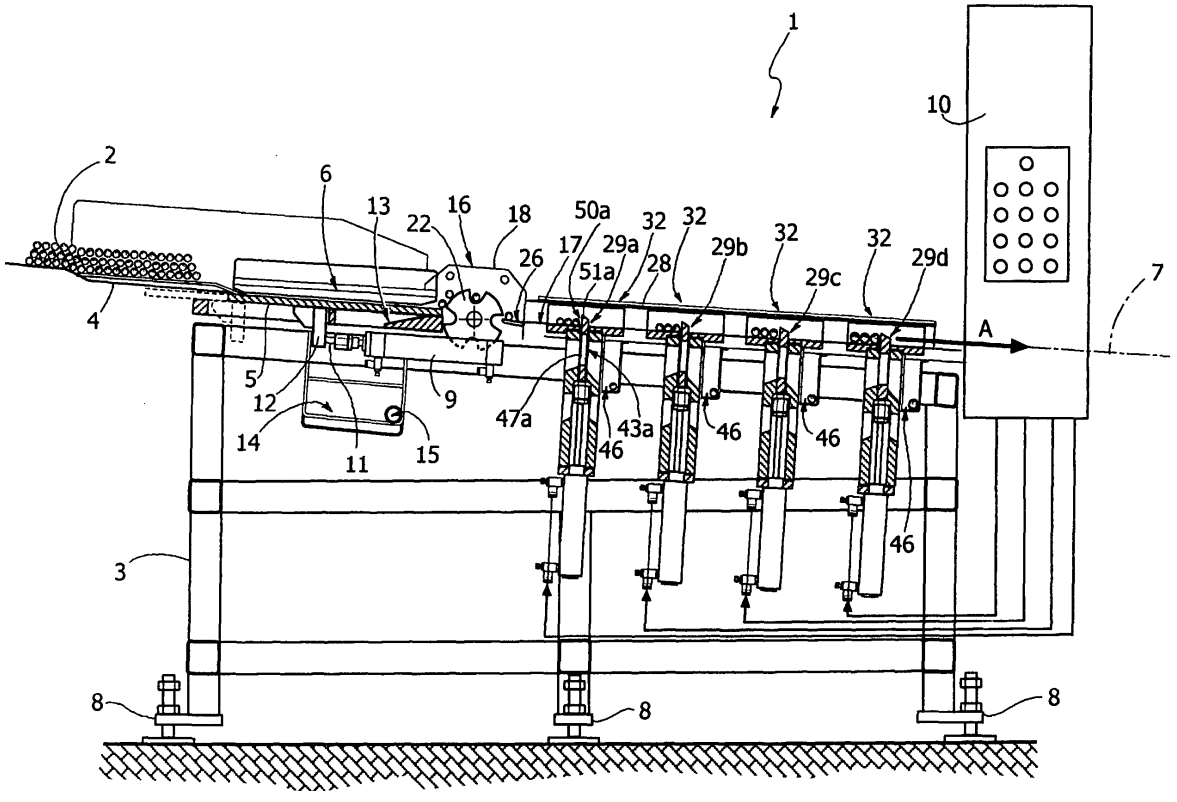
(54) **Ball sorting machine, and interchangeable module for such machine**

(57) A ball (2) sorting machine (1) is provided with a supporting plane (17) on which a flow of balls advances, in use, in a longitudinal advancement direction (A); the supporting plane has, along said longitudinal direction of advancement (A), a sequence of openings (29), which let the balls (2) fall, extend transversally and for the entire length of the supporting plane (17) and have a calibrated width for sorting the diameter of the balls to let fall; such calibrated width increases from one opening to the next, while the machine (1) is provided with movable members (47) to make the larger diameter balls, which have stopped between the lips (30) of the openings (29), advance in the longitudinal direction of advancement (A).

FIG. 1



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Description

[0001] The present invention relates to a ball sorting machine, in particular for ball bearings.

[0002] During the manufacturing of balls for bearings, it is known the need to sort balls which have reciprocally different diameters, for example at the output of a thermal treatment oven, for sorting the balls themselves into lots which are characterised by the same diameter and which are therefore uniform to proceed with the manufacturing process.

[0003] It is felt the need to discriminate between even minimal different diameters of the balls, for example differences of two tenths of a millimetre, without jamming the sorting machine and, therefore, without requiring interventions by operators.

[0004] At the same time, it is felt the need to obtain a high production rate, intended as the flow of sorted balls in kilograms per hour.

[0005] Preferably, there are felt the further needs of having a machine which is compact and/or rapidly and precisely settable to vary the diameters to be sorted.

[0006] It is the object of the present invention to provide a ball sorting machine, which allows to simply and cost-effectively respond to the aforementioned needs.

[0007] According to the present invention, a ball sorting machine, as defined in claim 1, is obtained.

[0008] For a better understanding of the present invention, it will now be described a preferred embodiment only by way of non-limitative example, and with reference to the accompanying drawings, in which:

- figure 1 is a schematic side elevation view, with parts in section, of a preferred embodiment of the ball sorting machine according to the present invention;
- figure 2 is a partial perspective view, on a magnified scale, of the machine in figure 1;
- figures 3 and 4 are similar to figure 1 and show, on a magnified scale, a detail of the machine in figure 1, in two operating conditions.

[0009] In figure 1, it is indicated by 1 a machine (schematically shown) for selecting and sorting balls 2 according to their diameter, in particular steel balls for ball bearings.

[0010] The machine 1 comprises a frame 3, which supports an input ramp 4 adapted to receive a flow of balls 2 output, for example, from a thermal treatment oven. The frame 3 also supports a wall 5 defining, over itself, a collecting station 6, in which the balls 2 arriving from the ramp 4 are accumulated in the direction of advancement shown by the arrow A along a longitudinal axis 7.

[0011] The direction of advancement A has, with respect to the horizontal, a descending inclination, which can be adjusted in known way and not described in detail by means of a plurality of adjustable feet 8 defining the floor support of the frame 3.

[0012] The wall 5 is retractable, for example if the machine 1 stops, to extract the balls 2 arriving in excess into station 6 and which would otherwise tend to either jam the machine 1 or get out from the sides which delimit the station 6 itself.

[0013] In particular, wall 5 slides in the opposite direction to the direction of advancement A towards a retracted position (shown by a broken line) underneath the ramp 4, and is operated by an actuator 9, automatically controlled by a control unit 10 constituting part of the machine 1. In the example shown in figure 1, the actuator 9 is defined by a pneumatic cylinder, whose stem 11 has an end fastened to a lower surface of the wall 5 by means of brackets 12. When the wall 5 is arranged in retracted position, the balls 2 fall from the station 6 along a descent 13 underneath, in opposite direction to the direction of advancement A, into a transversal channel 14 ending with a lateral hole 15 defining the outlet towards a collecting container (not shown) arranged by the side of the frame 3.

[0014] The frame 3 further carries a distributing device 16, which collects, from station 6, groups of balls 2 at predetermined time and transfers such groups onto a plane 17 arranged on the opposite side of the wall 5 along the axis 7 and essentially aligned with the wall 5 itself.

[0015] With reference to figure 2, the device 16 comprises two side heads 18, which are fastened to the frame 3, arranged at a distance equal to the width of the wall 5 and the plane 17, and are joined together by two horizontal rods 20 orthogonal to the axis 7. The device 16 further comprises a gearmotor 21 (partially shown) controlled by the control unit 10 and carried by the frame 3 by the side of the station 6, and a cylindrical distributing member 22 extending for the entire length of the wall 5 and the plane 17 between the heads 18 underneath the rods 20, is turnable about its axis 23 parallel to the rods 20 under the bias of the gearmotor 21 and has a plurality of straight grooves 25 on its external cylindrical surface. The grooves 25 extend along respective generating lines equally and reciprocally distanced about the axis 23 and are each shaped so as to collect and transfer at least one row of balls 2 parallel to the axis 23. In particular, the rotation speed of the member 22 is adjustable by the control unit 10 to vary the transfer time of the ball groups 2.

[0016] The ball groups 2 are deposited by the member 22 on an initial segment 26 of the plane 17. The plane 17 defines a longitudinal inclined track for the descending advancement, by gravity, of the balls 2 from the device 16 in the direction of advancement A, and is laterally defined by two vertical sides 28 parallel to the axis 7.

[0017] The plane 17 has, in the direction of advancement A, a sequence of slots 29a, 29b, 29c and 29d orthogonal to the axis 7 for letting the balls 2 fall from the plane 17. The slots 29a-29d extend with continuity for the entire length of the plane 17, i.e. is from one side to the other of the sides 28, and have calibrated widths, which are constant for each slot 29 to sort the diameter of the balls 2 to let fall and are increasing in the direction

of advancement A (from slot 29a to slot 29d).

[0018] The description that follows refers to only one of the slots 29 considering that the others differ essentially for their calibrated width.

[0019] The slot 29 is delimited by the lips 30 of the two members 31 (fig. 3), which define part of the plane 17 and are made of material having a relatively high surface hardness and resistance to wear. The two members 31 constitute part of an interchangeable module 32, which can be inserted between two fixed segments 33 of the plane 17, and is engageable in fixed position to the frame 3 in a way not described in detail. The module 32 comprises two L-shaped side brackets 34 and comprises respective vertical fins 35 constituting part of the sides 28 and respective opposite fins 36, which are fastened to the members 31 by means of screws or bolts 37 and carry respective eyebolts 38 for lifting the module 32.

[0020] With reference to figures 3 and 4, the module 32 further comprises two facing plates 41, 42 orthogonal to the plane 17 and reciprocally defining a passage 43, whose inlet is defined by the slot 29. In particular, the plates 41, 42 are fastened reciprocally fixed to their side ends in a way not shown, and to the members 31 by means of screws, whose head 44 is recessed in the members 31 themselves (fig. 2).

[0021] The plate 42 has an opening 45 defining the side outlet of the passage 43 to let the sorted balls 2 fall into a fixed transversal channel 46, which is separate from the module 32 and makes such balls roll down towards a container (not shown) arranged by the side of the frame 3.

[0022] The module 32 further comprises a plate or blade member 47, sliding in a seat 48 between the plates 41, 42, between a retracted or lowered position (figure 3), in which it defines a bottom surface 49 of the passage 43 to divert the fallen balls 2 towards the outlet 45, and an advanced or raised position (figure 4), in which it engages the passage 43 and the slot 29 so as to protrude above the plane 17 and define a resting surface 50 which stops all the arriving balls 2 upstream of the slot 29.

[0023] The upper end of the member 47, which selectively defines the surfaces 49 and 50, is shaped so as to provide, during the lifting through the slot 29, a biasing component in the direction of advancement A of the larger diameter balls 2 which were stopped between the lips 30. In particular, the surface 50 is orthogonal to the plane 17, while the surface 49 is flat and inclined upwards towards the outlet 45 and directly joined to the surface 50 by means of a straight upper edge 51 offset with respect to the half of the slot 29 in the opposite direction to the direction of advancement A.

[0024] The member 47 is operated by an actuator 52 constituting part of the module 32 and defined by a pneumatic cylinder, which comprises a liner 53 fastened to the lower end of the plates 41, 42 and a stem 54 aligned with the member 47, fastened onto the lower end of the member 47 and sliding in the seat 48.

[0025] The member 47 has a transversal series of lightening holes 56, while the plates 41, 42 have through holes 57 for facilitating the outlet of possible dirt fallen with the balls 2 through the slot 29 in the passage 43 and deriving from previous machining operations and/or treatments.

[0026] In use, with reference to figure 1, the balls 2 are tipped in a timed way, in the form of groups or rows, from the device 16 onto the segment 26 of the plane 17, and from here roll down in the direction of advancement A until they encounter the surface 50a associated to the slot 29a, where they stop.

[0027] After lowering the member 47a, the balls 2 tend to start off again by effect of gravity in the direction of advancement A. The balls 2 having a diameter smaller than the width of the slot 29a fall into the passage 43a and are collected in the respective container; those having larger diameter tend to stop between the lips of the slot 29a or to go beyond the slot 29a itself. At this point, the member 47a is raised so as to cause, by means of the edge 51a, the bias towards the slot 29b of the balls 2 stopped between such lips. At the end of the raising, the member 47a is again in the position to stop other arriving balls 2. Obviously, the operations described are similar for all the subsequent slots 29b-29d. Preferably, the members 47 are raised and lowered together by the control unit 10, synchronised by the cyclical distribution made by the device 16.

[0028] From the above, it is evident that the machine 1 has a high capacity, in terms of kilograms of sorted balls per hour, as the balls 2 are advanced in the direction of advancement A for the entire length of the plane 17, and not into a line. Furthermore, thanks to the bias of the upper end of the members 47 during the outlet, the balls 2 do not remain jammed between the lips 30, but are ejected from the slots 29 and made to advance.

[0029] The operation of the machine 1 is simple, because gravity is exploited to make the balls advance on the plane 17 and to convey the balls themselves into the collecting containers (not shown) through the channels 46. There are relatively few moving parts of the machine 1 and their reciprocating movement is extremely easy to control.

[0030] The modules 32 may be assembled, calibrated and tested individually off the machine, that is aside, before being fitted on the machine 1. Furthermore, the chosen configuration, i.e. the size of the slots 29, may be rapidly varied by changing the modules 32. At the same time, the modules 32 are extremely compact.

[0031] It is finally clear that changes and variations can be made to the machine 1 described and illustrated without departing from the scope of protection of the present invention, as defined by the accompanying claims.

[0032] In particular, different members for performing, respectively, the resting function for the balls upstream of the slots 29 and the advancement function of the balls 2 stopped between the lips 30 may be envisaged. Furthermore, the member(s), performing such functions may be arranged either over or by the side of the plane 17, instead of underneath the plane 17.

[0033] Furthermore, openings different than the slots 29 described may be envisaged, for example openings constituted by a series of reciprocally continuous inlets for the entire length of the plane 17, or openings not perfectly orthogonal to the axis 7.

[0034] Furthermore, the advancement on the plane 17 may be caused otherwise than by exploiting gravity, for example on level or upwards by means of a biasing transversal bar which pushes the rows of balls for the entire length of a plane; and/or the device 16 could be absent or replaced by a different device which dispenses groups of balls for at least part of the length of a plane.

[0035] Furthermore in the case of upward advancement, the stopping of the balls 2 upstream of the slots 29 could be avoided.

[0036] Finally, the evacuation of the balls 2 from the station 6 could be controlled in response to other alarm signals, in addition to the machine 1 stop signal.

Claims

1. A ball (2) sorting machine (1) **characterised by** comprising:

   - a supporting plane (17) on which a flow of balls advances, in use, in a longitudinal advancement direction (A);
   - a plurality of openings (29), which are made on said supporting plane (17) in reciprocal sequence along said longitudinal direction of advancement (A) to let the balls (2) fall from said supporting plane (17), extend transversally and for the entire length of said supporting plane (17), and have a calibrated width to sort the diameter of the balls to let fall; said calibrated width being increasing from an opening to the next; and
   - advancement means (51) movable to make the larger diameter balls, which have stopped between the lips (30) of the openings (29), advance in said longitudinal direction of advancement (A).

2. A machine according to claim 1, **characterised in that** said longitudinal direction of advancement (A) is descendingly inclined with respect to a horizontal direction.

3. A machine according to claim 1 or 2, **characterised in that** said openings (29) are defined by respective slots having constant calibrated width and orthogonal to said longitudinal direction of advancement (A).

4. A machine according to any of the preceding claims, **characterised by** comprising stop means (50) movable between a retracted position in which the smaller diameter balls are let fall through said openings (29), and an advanced position in which for each said opening (29), all the arriving balls (2) are stopped upstream of the opening (29) itself.

5. A machine according to claim 4, **characterised in that** said stop and advancement means (50, 51) are defined for each said opening (29), by a same movable member (47).

6. A machine according to claim 5, **characterised in that** said movable members (47) are slidable through the respective openings (29) between a lowered position, in which they let the smaller diameter balls fall, and a raised position, in which they define respective resting surfaces (50) protruding upwards from said supporting plane (17).

7. A machine according to claim 6, **characterised in that** the upper ends of said movable members (47) are shaped so as to provide, when raised through the respective openings (29), a biasing components in said longitudinal direction of advancement (A) of the larger diameter balls (2) which have stopped between the lips (30) of said openings (29).

8. A machine according to claim 7, **characterised in that** said movable members (47) have an edge (51) offset with respect to the half of said calibrated width in a direction opposite to said longitudinal direction of advancement (A).

9. A machine according to any of the claims from 5 to 8, **characterised by** comprising control means (10) for advancing and retracting said movable members (47) together.

10. A machine according to any of the preceding claims, **characterised by** comprising a distributing device (16) arranged upstream of said supporting plane (17) and configured so as to transfer the balls (2) in the form of groups with predetermined timing.

11. A machine according to claim 10, **characterised in that** said distributing device (16) comprises a motorised distributing member (22) for turning about its horizontal transversal axis (23) and having at least one external recess (25) for collecting and transferring said ball groups.

12. A machine according to any of the preceding claims, **characterised by** comprising a ball accumulation station (6) upstream of said supporting plane (17), and evacuation means (5, 9) for unloading at least part of the balls (2) from said accumulation station (6).

13. A machine according to claim 12, **characterised in that** said evacuation means (5, 9) comprise a wall

(5) defining a support for the balls in said accumulation station (6) and retractable to unload said balls (2).

14. An interchangeable module (32) for a ball (2) sorting machine (1) made according to any of the preceding claims, the module comprising:

- a supporting plane (17) on which a flow of balls advances, in use, along a longitudinal advancement direction (A);
- a single opening (29) made on said supporting plane (17) to let the balls fall from said supporting plane (17), extending transversally and for the entire length of said supporting plane (17), and having a calibrated width for sorting the diameter of the balls (2) to let fall; and
- advancement means (51) movable to make the larger diameter balls, which have stopped between the lips (30) of said opening (29), advance on the supporting plane (17) in said longitudinal direction of advancement (A).

15. An interchangeable module according to claim 14, **characterised by** being made according to the features of any one of any of the claims from 3 to 8.

FIG. 1

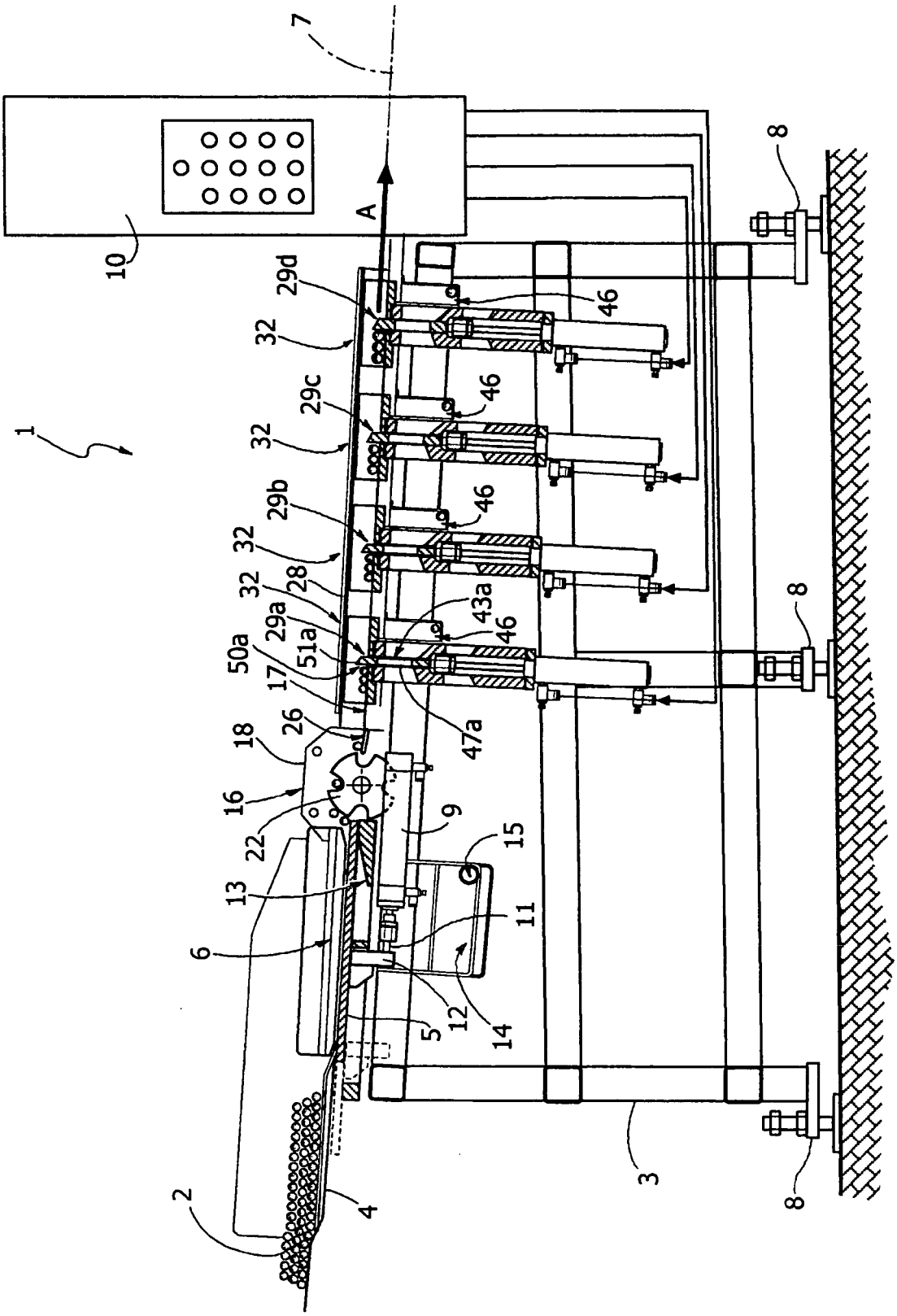
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FIG. 2

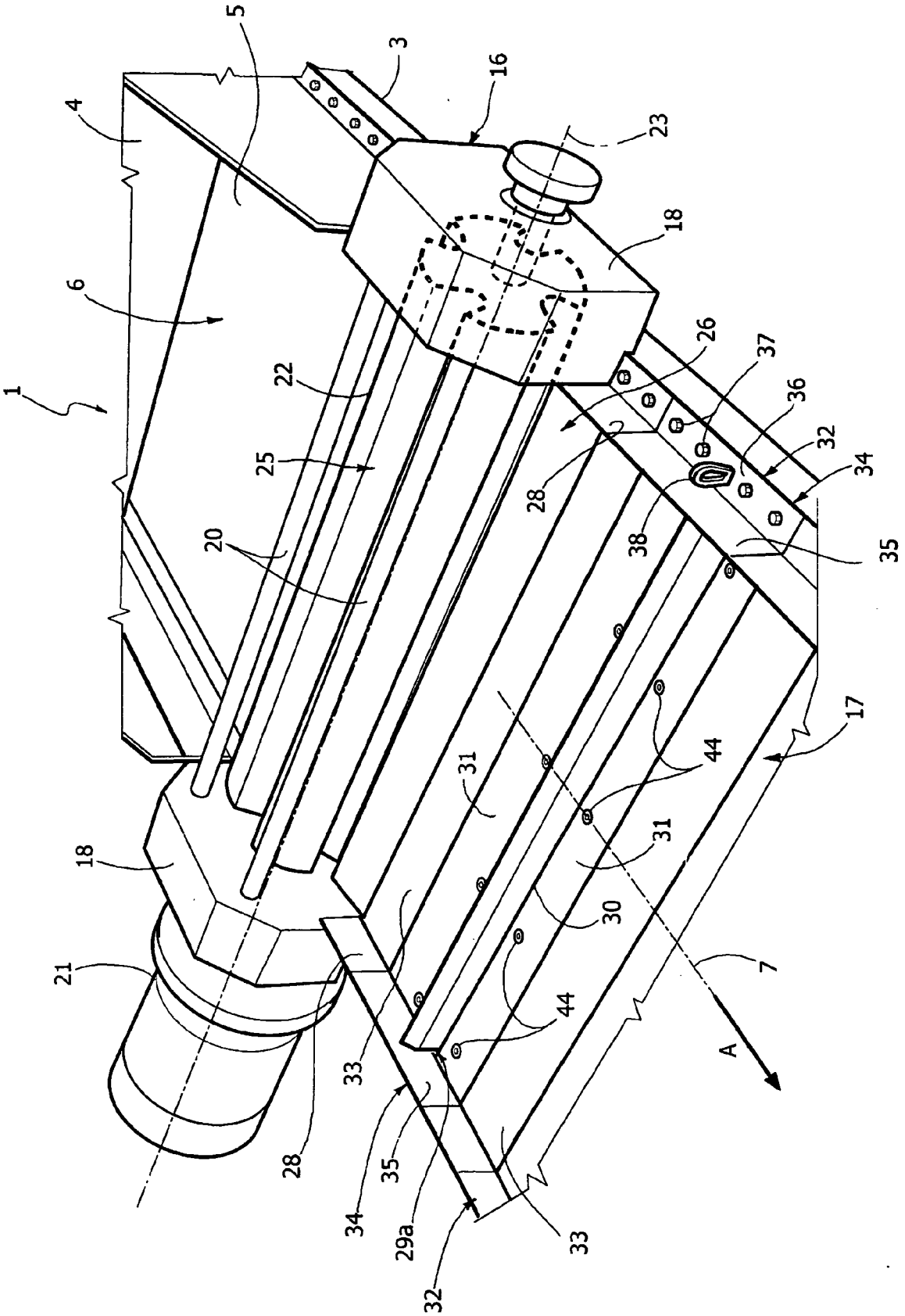
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FIG. 3

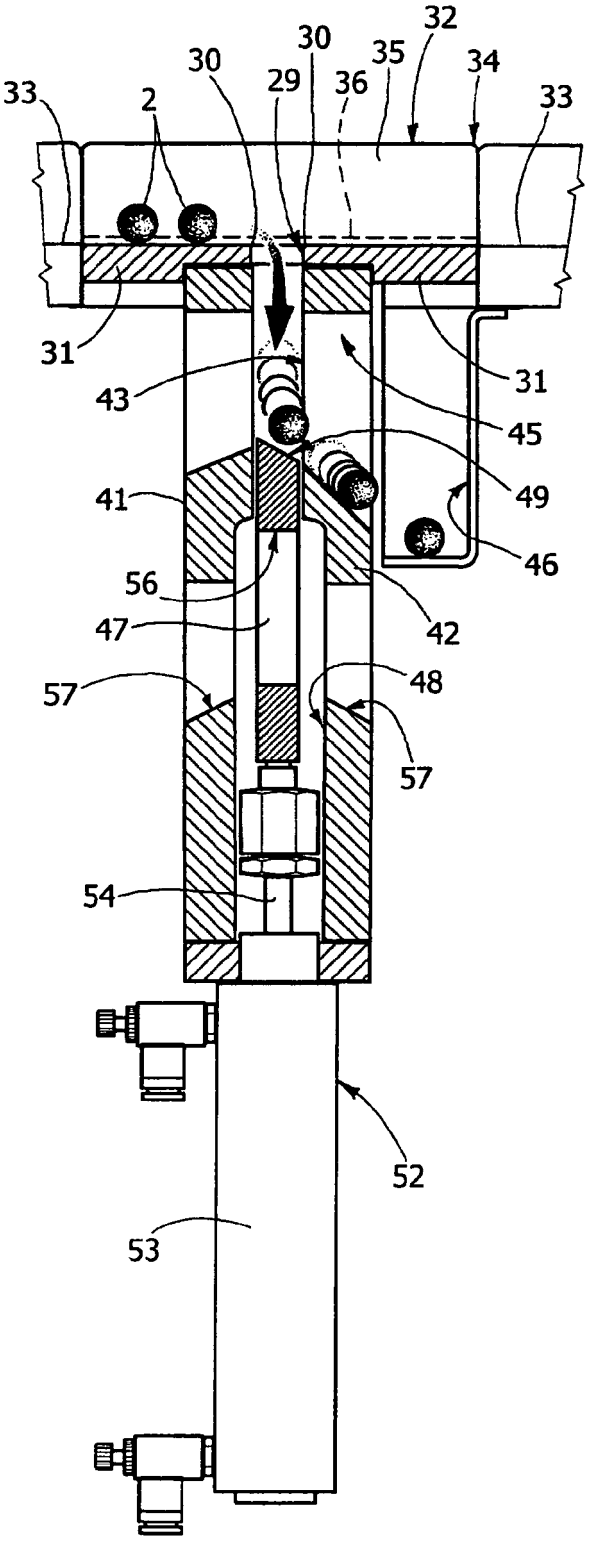
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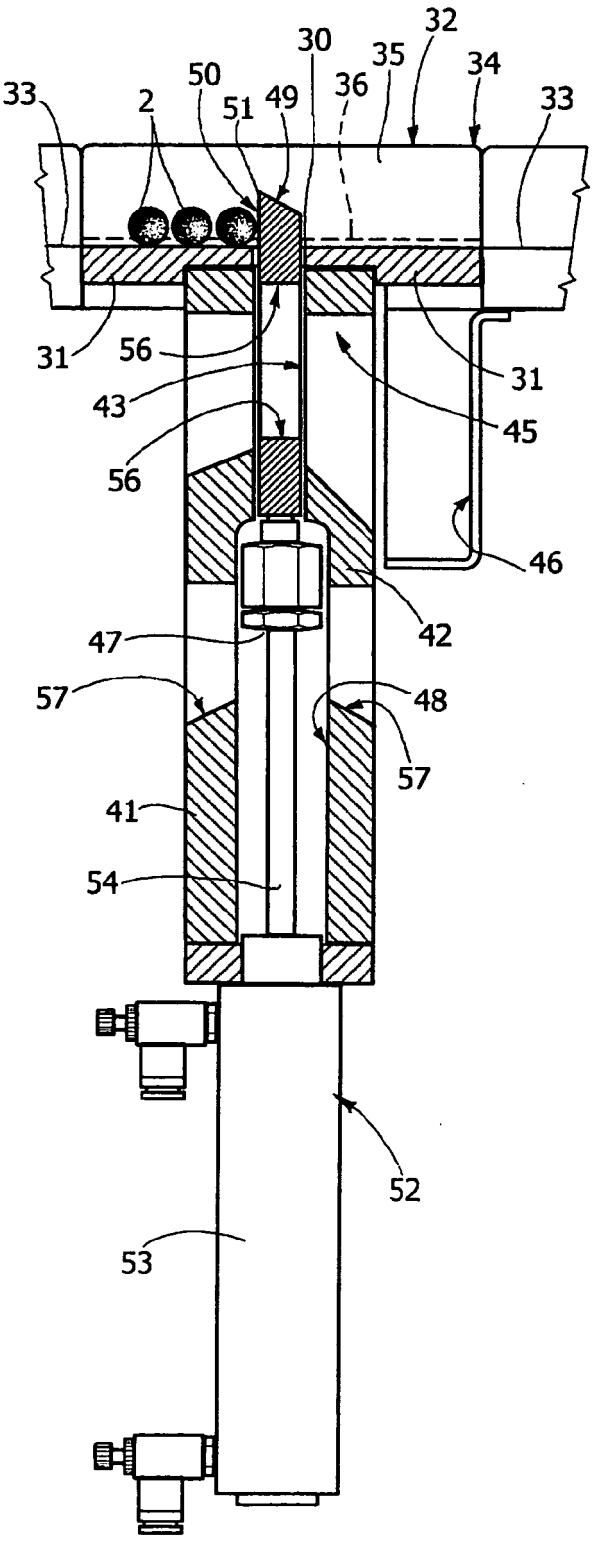
FIG. 4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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 42 5886

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 455 446 A (EDWARD H. BEAZLEY) 15 July 1969 (1969-07-15) * column 1, line 13 - line 27 * * column 2, line 13 - line 17 * * column 3, line 21 - line 71 * * column 4, line 43 - line 52 *	1-3,6-9	INV. B07B13/07
Y	* the same passages *	14,15	
Y	US 3 797 659 A (KAUFFMAN J,US) 19 March 1974 (1974-03-19) * column 1, line 3 - line 30 *	14,15	
A	US 4 172 527 A (BOST, JOHN R) 30 October 1979 (1979-10-30) * column 2, line 41 - line 44 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

B24B
B07B

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
Munich	22 May 2006	Militzer, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

3

EPO FORM 1503 03.82 (P04C01)

European Patent Office

Application Number
EP 05 42 5886

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-9, 14, 15

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 05 42 5886

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-9,14,15

   A ball sorting machine and interchangeable module therefor

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2. claims: 10-13

   A ball distribution device having an ball accumulation station

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 42 5886

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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22-05-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3455446 A	15-07-1969	NONE	
US 3797659 A	19-03-1974	CA 982985 A1	03-02-1976
US 4172527 A	30-10-1979	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82