

The invention relates to a drum filling machine of the type referred in the precharacterising portion of claim 1.

5 Semi- or fully- automatically operating drum filling machines for individual drums or for a plurality of drums arranged on pallets must move the working position of a tool carriage by relative alignment above the bunghole of the next drum to be processed and then control the
10 movement of the tool carriage such that the tools arranged on it successively unscrew the screw lid, fill the drum, screw a lid on again and optionally also apply a clinch cap. Individual tools are provided for this purpose, such as screwers, filling valves, clinchers etc.
15 When a drum is finished, the working position of the tool carriage must be aligned above the bunghole of the next drum to be processed.

20 With drum filling machines for filling drums arranged on pallets there is the additional object that a plurality of drums are arranged on a pallet which are, if possible, to be filled automatically with a programmed controller. The working position of the tool carriage must thus be moved successively into correctly aligned engagement with
25 all the bungholes.

30 Fully automatic operation is desired with such drum filling machines since they are frequently used for filling poisonous or explosive substances which would endanger an operative stationed in the vicinity.

Known drum filling machines of the type referred to above can already fill drums substantially automatically but have problems in determining the positions of the

bungholes of the different drums on the pallet for the control program. Thus it is known, for instance, that the control program only recognises fixed bunghole positions. The drums must therefore be precisely aligned in advance for such machines so that the bungholes are in precisely predetermined positions which may be achieved, for instance, with jigs. A further possibility is manually to approach all the bungholes before the beginning of the filling process in a "teaching" method and to input the positions into the program whereafter the machine can then fill automatically. All these known machines, however, necessitate the presence of an operative, at least temporarily, or require that the drums be placed on the pallets in a highly precisely predetermined manner.

It is thus the object of the present invention to provide a fully automatic drum filling machine of the type referred to above which is more suitable for poisonous and, in particular, explosive filling material.

This object is solved in accordance with the invention with the features of the characterising portion of claim 1.

In accordance with the invention a line camera is provided on the filling machine which can view the positions of the bungholes whilst performing relative movement above the drum surfaces and input them into the control program. Randomly positioned drums can thus be filled completely automatically, that is to say without an operative on station. A line camera is particularly advantageous because it is substantially cheaper, both as regards acquisition and also as regards the computer

program expense, than a surface-viewing camera. Furthermore, it has the advantage that the necessary subject illumination can be limited to one line. Substantially lower lighting energy is thus necessary which represents a substantial constructional advantage for complying with explosion protection regulations.

The features of claim 2 are also advantageously provided. The camera could be moved over the pallet for the relative movement. However, a separate individual actuator would be necessary for the camera which would again be disadvantageous for reasons of cost and explosion protection. Since the pallets must in any event be conveyed through the filling machine, the transport device provided for this purpose can be used in a simple manner for the relative movement between the pallet and camera.

The features of claim 3 are also advantageously provided. In this arrangement all the drums on the pallet are viewed by the line camera before the first bunghole moves into processing engagement with the working position of the tool carriage. Thus before the first bunghole is approached by the tools, all the bungholes are stored in the control program and a path optimisation can be carried out before the seeking process begins.

The features of claim 4 are also advantageously provided. The tool carriage, which is usually used only for tool replacement but not for seeking the bungholes, is used in accordance with the invention for both movements so that an additional actuator is saved which again simplifies the adherence to strict explosion protection regulations.

Finally, the features of claim 5 are advantageously provided. This is advantageous particularly with pallets which have only two drums next to one another in the line direction. When only a narrow edge strip of these lying
5 towards the centre is viewed, the line can be very short, for instance only half a drum diameter in length. The advantage of this is that with a given line camera the resolution can be increased. However, at least a coarse prealignment of the drums is necessary so that the
10 bungholes all point substantially towards the centre.

A preferred embodiment of the drum filling machine in accordance with the invention is shown schematically by way of example in perspective in the drawing.

15 The drum filling machine shown in the Figure is to fill drums 1 which, as shown in the Figure, stand in fours on a pallet 2 which rests in the machine on a conveyor belt 4 which is driven by a motor 3 and which is movable in
20 the direction of the arrow 5.

Fixedly arranged adjacent the conveyor belt is a column 6 on which is arranged a tool carriage 10 which is vertically movable in the direction of the arrow 8 with
25 a vertical actuator 7 and movable transverse to the direction of the arrow 5 in the direction of the arrow 9 with a transverse actuator.

In the illustrated simplified exemplary embodiment the
30 tool carriage 10 carries only two drum processing tools, namely a filling valve with a filling tube 11 and a suction device 12 and a screwer 13.

The drum processing tools 11 and 13 can be moved in the

direction of the arrows 5,8 and 9 into engagement with all the bungholes 14 of the drums 1 with the three actuators. A control computer, which is not shown and to which the actuators are connected in a suitable manner, is provided for controlling the actuators.

Provided on a fixedly arranged bracket 15 for the purpose of determining the positions of the bungholes 14 is a line camera 16 which views an observation line 17 with the illustrated viewing angle α which extends transverse to the direction of movement 5.

If the pallet 2 is moved by the conveyor belt 4 in the direction of the arrow 5 beneath the line camera, the entire surface can be viewed and provided as an input to the control computer which can determine the bunghole positions.

In the illustrated exemplary embodiment the length of the control line 17 is shorter than the breadth of the pallet 2. This necessitates the drums 1 having to be roughly prealigned so that the bungholes lie substantially towards the centre. Since the line is substantially shorter, the camera which is provided has an increased point resolution or with the same resolution a simpler and cheaper camera can be used. The line can, however, also be longer and view the entire breadth of the pallet 2 so that the entire drum surfaces may be viewed. This is advantageous, when not only two drums stand next to one another, as in the illustrated exemplary embodiment, but a larger number of drums is positioned on the pallet.

In the illustrated exemplary embodiment of the machine the line camera 16 is positioned in front of the tool

carriage 10 in the transport direction of the arrow 5 by a distance which is larger than the length of the pallet 2. When moved in the transport direction (in the direction towards the end of the conveyor belt 4 having the motor 3) the pallet is firstly completely viewed by the line camera before the first bunghole moves into processing engagement beneath the tool carriage 10. The control computer can thus firstly determine all the bunghole positions and perform a path optimisation before the first bunghole is to be approached. As shown by the arrow 5, the conveyor belt 4 can also be driven reversibly in both directions and, for instance, move the pallet 2 many times beneath the line camera 16 to increase the reading precision.

The control computer then starts the tool carriage 10 moving and initially moves the screwer 13 into position above the first bunghole to be processed. The screwer 13 is lowered onto the bunghole with the vertical actuator 17 or optionally with an individual vertical actuator on the screwer and unscrews the drum. The tool carriage 10 is then moved until the filling tube 11 comes into alignment above the same bunghole. The drum is filled. The tool carriage 10 is then moved back again until the screwer 13 comes into engagement and the drum is screwed up again.

Further tools can be provided on the tool carriage 10, for instance a clincher which can be moved in the same manner into engagement with the same bunghole.

When the processing of a bunghole has been completed, the conveyor belt 4 and the tool carriage are moved until the screwer 13 is in engagement above the next bunghole to be

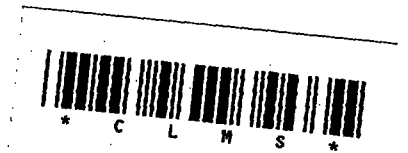
processed. The drum processing cycle then begins from the beginning in the manner described. All the bungholes are dealt with successively in this manner. Since the position of the individual bungholes was previously stored in the control computer, the movements can be optimised by suitable control of the actuator. If the conveyor belt 4 is reversed the bungholes can, for instance, be dealt with in a circle.

The illustrated drum filling machine can be substantially modified within the scope of the present invention.

Only one carriage, namely the tool carriage 10, is provided in the illustrated exemplary embodiment to control the tools 11 and 13 in the direction of the arrow 9, that is to say transverse to the pallet transport direction 5. This serves not only to change the tool but also for approaching a new bunghole position in the direction transverse to the pallet transport direction. These control movements (bunghole seeking movement and tool changing movement) can however be performed by separate carriages, whereby, for instance, the bunghole search is effected with a compound slide arrangement and the tool carriage 10 is provided as a subsidiary carriage.

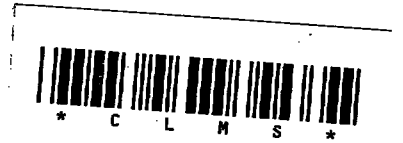
The line camera 16 can also be arranged differently to that shown, namely directly on the track of the tool carriage fixed in the direction of the arrow 9. It then views the bungholes in the engagement region of the tool carriage. Path optimisation for the approach to the bungholes is also possible, whereby, for instance, the pallet 2 can move on two successive occasions beneath the position of the tool carriage, the first time for reading

the positions into the control computer and the second time for the processing operations.



CLAIMS

- 5 1. Drum filling machine for filling a plurality of drums arranged on a pallet with a controllable tool carriage arranged above the drums, which moves the different drum processing tools successively into engagement with the said bunghole, and with a seeking device, which controls the working position of the tool carriage and the pallet relative to one another to seek the next bunghole to be processed, the position of which is stored in a control computer, characterised in that a line camera (16) is provided which is connected to the control computer and views the drum surfaces and which is movable transverse to the line direction (in the direction of the arrow 5) relative to the pallet (2) and which serves to determine the position of the bungholes and to input it into the control program.
- 10 2. Drum filling machine as claimed in claim 1, characterised in that the camera (16) is fixed and the pallet (2) is moved by a transport device (conveyor belt 4).
- 15 3. Drum filling machine as claimed in claim 2, characterised in that the distance between the line camera (16) and the tool carriage (10) in the transport direction (arrow 5) of the pallet (2) is greater than the length of the pallet.
- 20 4. Drum filling machine as claimed in one of claims 2 or 3, characterised in that the tool carriage (10) is driven in the direction transverse to the transport direction (5) of the pallet (2) and is controllable both
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for changing the tools (11,13) and for seeking the
bungholes (14).

5. Drum filling machine as claimed in one of the
preceding claims, characterised in that the line camera
(16) views the drums lying at the ends of the line only
in an edge region lying towards the centre of the line.