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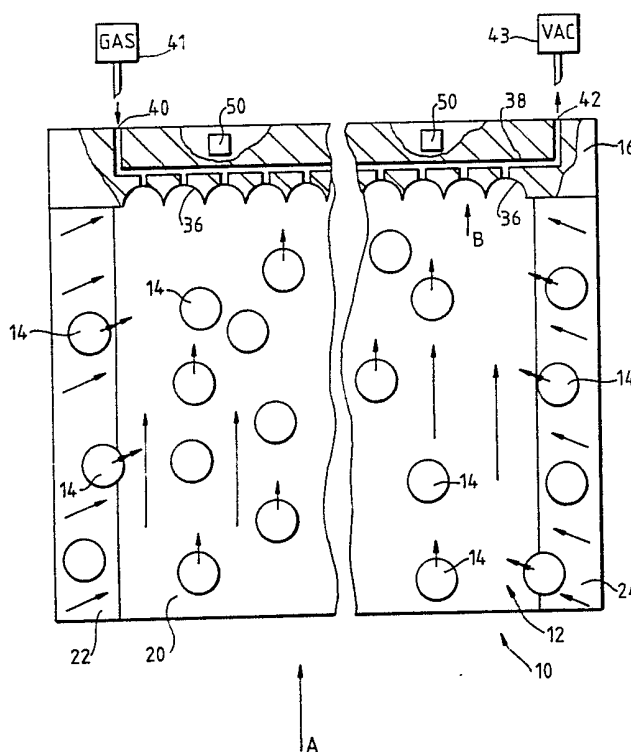
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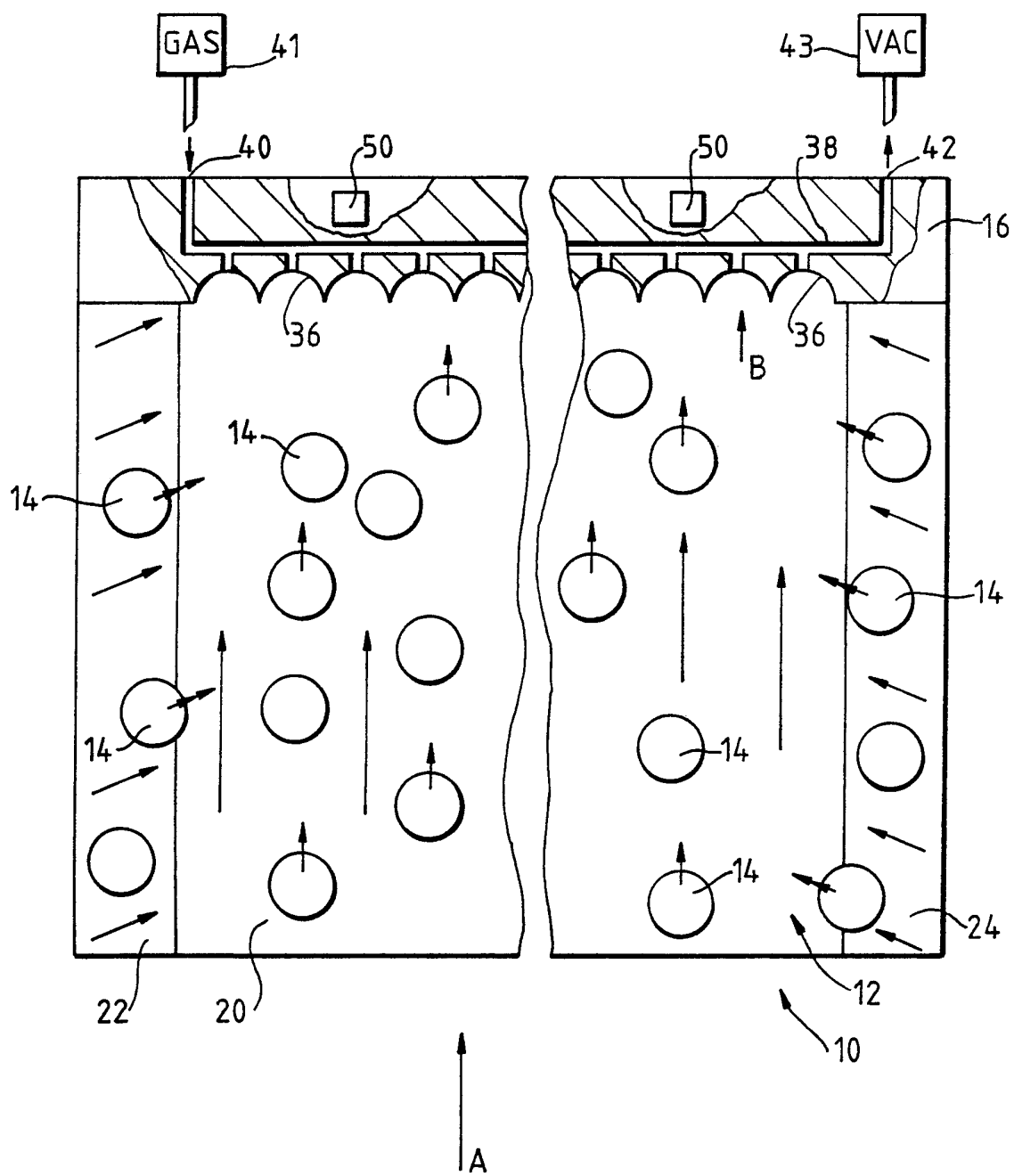
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INT CL<sup>5</sup> **B66C 1/02**

(54) **Apparatus for sorting and packing objects**

(57) A fuel pellet sorting and packing apparatus 10 comprising a conveyor 12 and a movable gripper device 16 extending across the conveyor 12. The gripper device 16 has a large number of near semi-cylindrical cavities 36 into which upstanding pellets 14 can be fed from the conveyor 12. Vacuum pressure applied at the cavities 36 holds the pellets 14 thereto so that they can be lifted with the gripper device 16 and placed at a packing station.

*Fig.1*



*Fig.1*

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Fig. 2

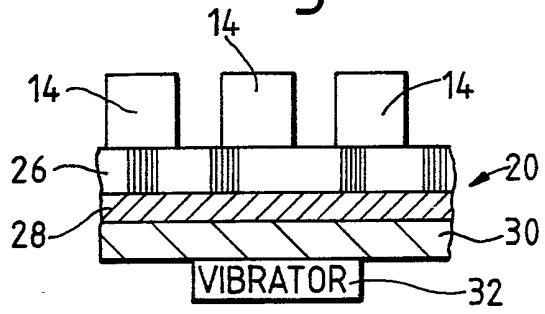


Fig. 3

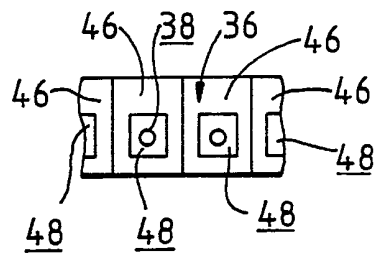
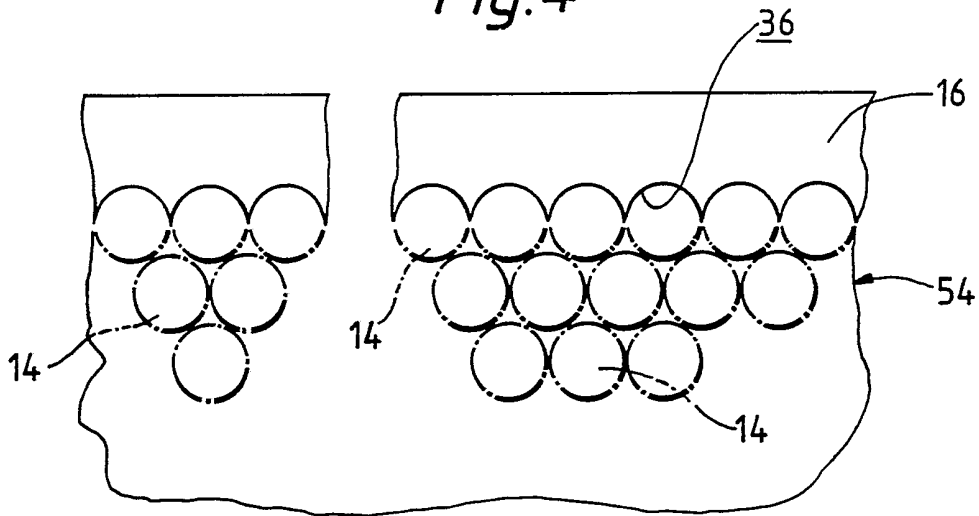


Fig. 4



Apparatus for sorting and packing objects

This invention relates to the sorting and packing of objects, and more particularly but not exclusively to cylindrical objects.

5 In some operations it is advantageous to pack objects such as right cylindrical pellets for subsequent processing, for example sintering. When manual handling of the objects is precluded for one reason or another, difficulties can be experienced in designing apparatus  
10 for handling the objects that will allow the objects to be sorted and then very closely packed with objects already packed for subsequent processing.

The invention, therefore, provides apparatus for sorting and packing objects, the apparatus comprising  
15 conveyor means for feeding objects, means for collecting the objects from the conveyor means, said collecting means comprising an array of sealing surfaces disposed across the conveyor means, said surfaces being adapted to correspond with the shape of a portion of the sides  
20 of said objects, means to apply a vacuum pressure at the sealing surfaces so as to cause the objects to adhere thereto, and means for moving the collecting means to a collecting station, whereby the objects can be deposited onto the collecting station by release of the vacuum  
25 pressure.

Preferably, there are provided means for applying a gas pressure to the sealing surfaces. Advantageously,

the objects comprise cylindrical pellets, for example nuclear fuel pellets.

It can be seen that as the collecting means holds the objects at one side thereof, subsequent packing of the objects with other objects at the collecting station is facilitated.

The invention will now be further described by way of example only with reference to the accompanying drawings, in which:

Figure 1 shows a plan diagrammatic representation of part of a sorting apparatus;

Figure 2 shows a fragmentary view in the direction of arrow A of Figure 1;

Figure 3 shows a fragmentary view in the direction of arrow B of Figure 1, and

Figure 4 shows a fragmentary plan representation of a station for packing objects.

Referring now to Figure 1, and Figure 2, an apparatus 10 is shown and comprises a conveyor 12 for feeding objects in the form of right cylindrical pellets 14 towards a movable collector 16. The conveyor 12 is of the kind described in our co-pending patent application No 8918651.4 (United States Serial No filed 1989) which is incorporated by reference herein. The conveyor 12 comprises cushion elements 20, 22, 24 respectively, each comprising a multiplicity of extremely fine and relatively short

flexible synthetic polymer fibres 26 packed at an inclined orientation as an ultra-high density pile in a plastics backing 28. The directions of inclination of the fibres in the cushion elements 20, 22, 24 are shown by the single-headed arrows. The cushion elements 20, 22, 24 are carried by a support member 30 which is arranged to be vibrated by at least one vibrator 32. The high density pile is between  $68 \times 10^6$  and  $80 \times 10^6$  fibres per square metre, with nylon fibres 26 having a thickness of between 43 and 45 microns and up to 2.5 mm long. The fibres 26 have an orientation of between 70° and 80° from the backing 28 of glass fibre reinforced vinyl.

The collector 16 extends across the conveyor 12 and has a continuous array of cavities 36 which are slightly less than semi-cylindrical and correspond with the cylindrical shape of the pellets 14. A duct 38 having an inlet 40 from a gas pressure source 41 and an outlet 42 to a vacuum source 43 is connected to each cavity 36 in parallel. As shown in Figure 3, each cavity 36 is lined with a rubber seal 46 which is adapted to engage the side of a respective pellet 14. The rubber seal 46 has an inner space 48 of sufficient area to expose the duct 38, and to generate the suction force necessary to hold the pellet 14 firmly to the collector 16 when the collector 16 is raised from the conveyor 12. Two stubs 50 of square section on the collector 16 are adapted for

location by a lifting arm (not shown), which can lift the collector 16 to a station 54 (see Figure 4) where pellets 14 are packed at a high density, the pellets 14 being shown in broken line for clarity. It will be apparent that no portion of the collector 16 intrudes into the space occupied by any pellets 14 already packed at the station 54. Very close packing of the pellets 14 can, therefore, be achieved at the station 54 which might be a tray to be passed to a sintering furnace (not shown).

In operation, upstanding pellets 14 are fed to the conveyor 12 and under the action of the vibrations on the cushion elements 20, 22, 24, the pellets 14 move towards the collector 16. The directions of the pellets 14 are shown by the double-headed arrows under the effect of the inclination of the fibres 26 in the cushion elements 20, 22, 24. At the collector 16, the pellets 14 jostle until all the cavities 36 are occupied. A vacuum pressure (eg 11-27 inches Hg) is then applied from the vacuum source 43 to the duct 38 at the outlet 42 with the inlet 40 closed. Under the effect of the vacuum pressure the respective pellet 14 is held against the seal 46 in each cavity 36. The collector 16 can now be raised with those pellets 14 in the cavities 36, and placed at the station 54 where the vacuum pressure is released to free the pellets 14 from the cavities 36. Should it be necessary a low (eg 5

psi) gas pressure can be applied from the gas source 41 to the inlet 40 to overcome any residual adhesion between the seals 46 and the pellets 14. The gas pressure may also be applied to flush out any particulate matter that may accumulate in the cavities 36 after the pellets 14 have been released and before the collector 16 is returned to the conveyor 12. Furthermore, during the removal of the collector 16 from the conveyor 12, operation of the conveyor 12 can be continued to sweep away any part-pellets or debris from the conveyor 12.

Although the use of a conveyor having cushion elements is preferred, other conveyor devices may be used.

The invention has an application in the packing of green pellets of nuclear fuel material in receptacles for subsequent sintering of the pellets. An advantage of the invention is that it does not apply a compressive force on the sides of the pellet. In such an application, the green pellets might be 10 mm diameter and 12 mm high, although it will be understood that other sizes of green pellets may be used in the invention.

It will be appreciated that other features of conveying devices, for example, for orientating the pellets into an upstanding position might be used.



Claims

1. Apparatus for sorting and packing objects comprising conveyor means for feeding objects, means for collecting the objects from the conveyor means, said  
5 collecting means comprising an array of sealing surfaces disposed across the conveyor means, said surfaces being adapted to correspond with the shape of a portion of the sides of said objects, means to apply a vacuum pressure at the sealing surfaces so as to cause the objects to  
10 adhere thereto, and means for moving the collecting means to a collecting station, whereby the objects can be deposited onto the collecting station by release of the vacuum pressure.
2. Apparatus as claimed in Claim 1, including means  
15 for applying gas pressure to the sealing surfaces.
3. Apparatus as claimed in Claim 1, or Claim 2, in which the surfaces are part-cylindrical.
4. Apparatus as claimed in any preceding Claim, in  
20 whch the conveyor means comprises cushioning means, and means for vibrating the cushioning means.
5. Apparatus as claimed in any preceding Claim, in which the objects comprise nuclear fuel pellets.
6. Apparatus for sorting and packing objects  
substantially as hereinbefore described with reference  
25 to and as shown in the accompanying drawings.

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