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(54) Device for lifting objects by making use of a sub-atmospheric pressure.

(57) The invention relates to a device for lifting objects (15) by making use of a sub-atmospheric pressure, whereby the device is provided with a chamber (42) in which a sub-atmospheric pressure can be generated. A valve (45) located in said chamber has a valve stem (44) extending to a point beyond the chamber (42), through a passage (43) provided in the bottom wall (40) of the chamber. The lower end of the valve stem (44) is located near an opening (11) surrounded by resilient material (10), which is located at the bottom side of the device. The valve (45) and the valve stem (44) can be put from a first position, in which the passage (43) in the bottom wall (40) of the chamber (42) is closed by the valve, into a second position, in which the valve is located spaced from the bottom wall, and in which the chamber (42) is in open communication with the opening (11) surrounded by the resilient material (10). The valve (45) is secured to the lower end of a bellows-shaped means (46) disposed in the chamber (42), said bellows-shaped means being retained between the valve (45) and a fastening means (47, 48) located spaced from the bottom wall (40) of the chamber (42). The interior of the bellows-shaped means (46) is in open communication, via a passage (49) provided in the valve (45) and in the valve stem (44), with the opening (11) surrounded by the resilient material (10).

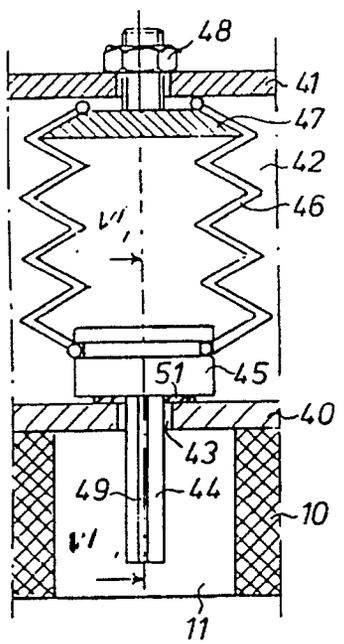

FIG. 4

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DEVICE FOR LIFTING OBJECTS BY MAKING USE OF A SUB-ATMOSPHERIC PRESSURE.

The invention relates to a device for lifting objects by making use of a sub-atmospheric pressure, said device being provided with a chamber in which a sub-atmospheric pressure can be generated.

Such a device is known from US Patent Specification No. 4,787,662. With this known device the chamber in which a sub-atmospheric pressure can be generated is in open communication, via throttle passages, with openings located at the bottom side of the device which are surrounded by resilient material. When the device is to be used it is placed on the objects to be moved, and a sub-atmospheric pressure will be generated in those openings that are covered by the objects as a result of which the object will stick to the device. At the location of the openings which are not covered by an object there will be an air flow. In particular when irregularly shaped objects are picked up and/or when several small objects are picked up by one and the same device it may happen that a comparatively large number of openings is not covered by (an) object(s), so that during operation there will be a comparatively large air flow through the openings that are not covered, which makes it necessary for the means for generating the sub-atmospheric pressure to have ample capacity.

In order to meet this drawback use is made according to the invention of a device for lifting objects by making use of a sub-atmospheric pressure, whereby the device is provided with a chamber in which a sub-atmospheric pressure can be generated, as well as with a valve located in said chamber and a valve stem fixed to the valve, said valve stem extending to a point beyond the chamber, through a passage extending in the bottom wall of the chamber, and with a bellows-shaped means connected to the valve and the valve stem, whereby the lower end of the valve stem is located near an opening surrounded by resilient material, which is located at the bottom side of the device, all this in such a manner that the valve and the valve stem can be put from a first position, in which the passage in the bottom wall of the chamber is closed by the valve, into a second position, in which the valve is located spaced from the bottom wall, and in which the chamber is in open communication with the opening surrounded by the resilient material.

Such a device is known from US-A-4,561.687. In this known device the valve stem projecting beyond the bottom wall of the chamber is surrounded by the bellows-shaped means, which at its lower end is connected, via a connecting piece, to the lower end of the valve stems and which at its upper end is secured to the bottom wall of the chamber. Near its lower end the bellows is thereby in open communication with the opening surrounded by the resilient material. The bellows-shaped means functions mainly to effect a flexible connection between the connecting piece provided at the lower end of the valve stem and the remaining part of the device. The valve located inside the chamber is at all times during operation subjected to the sub-atmospheric pressure prevailing in the chamber, which may involve the risk that a good seal of the passage cannot be ensured in the position in which the valve must close the passage.

According to the invention the valve is secured to the lower end of the bellows-shaped means disposed in the chamber, said bellows-shaped means being retained between the valve and a fastening means located spaced from the bottom wall of the chamber, whilst the interior of the bellows-shaped means is in open communication, via a passage provided in the valve and in the valve stem, with the opening surrounded by the resilient material.

When using the construction according to the invention a pressure equal to the sub-atmospheric pressure will prevail in the interior of the bellows-shaped means, said pressure being exerted on the upper side of the valve, so that said valve will be positively forced into the position in which the passage in the bottom wall is closed. When the valve is forced into its open position, in order to generate a vacuum in the opening surrounded by resilient material, however, a sub-atmospheric pressure will also be generated in the interior of the bellows, so that the closing force exerted in the closed position is released.

A further advantage of the construction according to the invention is that as a result of its arrangement in the cabinet the bellows-shaped means is well-protected, as a result of which damage to the bellows-shaped means can be avoided to a great extent.

With the embodiment according to US-A-4,561,687 it is furthermore necessary to dispose the coupling means secured to the lower ends of the valve stems and supported by the bellows-shaped means separated from each other, in order to be able to ensure that the device operates in the intended manner, which leads to a vulnerable and complicated construction. According to the invention it is on the other hand possible to design the device such that a plurality of valves, with the associated bellow-shaped means, are arranged in a common chamber, and that a resilient material bounding a number of openings is provided at the

lower side of the bottom wall bounding the chamber.

In this way a particularly solid and simply produced device can be obtained.

According to a further aspect of the invention use is made of a device for lifting objects by making use of a sub-atmospheric pressure, whereby the device is provided with a chamber in which a sub-atmospheric pressure can be generated, said chamber being in open communication, via a passage, with a room in which a ball is present, said room being in communication with an opening surrounded by resilient material located at the bottom side of the device, all this in such a manner that when air tends to flow to the chamber via said opening and said room, as a result of a sub-atmospheric pressure being generated, said ball is moved upwards towards the passage in order to close said passage.

Such a device is known from FR-A-2,265,659 (Figure 5). With this known device the ball is accommodated in a cage with perforated walls, which is located spaced from the opening surrounded by resilient material. The use of such a cage with perforated walls leads to a complicated construction, whilst there is also the risk of the perforations having a comparatively small passage becoming clogged.

According to the invention the room accommodating the ball is formed by a bore having a diameter which is larger than the diameter of the ball, a further passage connecting to the bottom side of said room, said further passage forming the connection between the bore accomodating the ball and the opening surrounded by the resilient materials whilst the ends of the bore form conical seats for the ball.

By using the invention a particularly simple construction can be obtained, wherein the risk of the flow path for the air becoming fouled is practically neglectable.

The invention will be further explained with reference to a few embodiments of the construction according to the invention illustrated in the accompanying Figures.

Reference is hereby made to a device, which is in particular intended for picking up bricks or the like. It will be apparent, however, that the construction according to the invention may also be used for moving other objects.

Figure 1 diagrammatically shows an installation for removing, layer by layer, layers of bricks from brick piles present on a kiln car, by making use of a device according to the invention.

Figure 2 diagrammatically shows a bottom view of a device according to the invention.

Figure 3 is a larger-scale view of a part of Figure 2.

Figure 4 is a larger-scale sectional view of a part of the device illustrated in Figures 2 and 3, near an opening.

Figure 5 is a sectional view corresponding with Figure 4, with an object placed under the opening.

Figure 6 is a sectional view of the valve, along the line VI - VI in Figure 4.

Figure 7 is a sectional view corresponding with Figure 4 of a second embodiment of the device according to the invention.

Figure 8 is a sectional view corresponding with Figure 7, with an object placed under the opening.

Figure 1 shows an installation for removing. layer by layer, layers of bricks which are piled on top of each other in brick piles 1 which are present on a kiln car 2.

After baking the bricks usually show variations as to colour and shape, dependent on the fact whether the bricks form part of a pile placed near the side of the kiln car, and/or whether the bricks are located near the top or the bottom of the pile. In many cases it is desirable, therefore, to be able to mix the stones in a simple manner. For this purpose it is required to take down, layer by layers the piles built up of layers of bricks resting on top of each other, whereby it is furthermore required to be able to remove a layer from the one pile and a layer from another pile at random.

In order to realise this use is made according to the invention of an installation illustrated in Figure 1, which comprises a portal 3, under which a kiln car 2 is to be arranged in the illustrated manner. Across the upper side of the portal a traversing trolley 3′ can be driven to and fro in the direction according to the arrow A. Said traversing trolley supports a device 4 for lifting the bricks. The device 4 can thereby be moved up and down by means of a setting cylinder 5. The device 4 to be described in more detail hereinafter picks up the objects, bricks in this case, by using a sub-atmospheric pressure. An air pump or fan 6 is mounted on the traversing trolley 3 in order to generate the sub-atmospheric pressure in the device 4. By means of the device 4 an upper layer of bricks can be respectively picked up from one of the piles 1, and such a layer can then be placed on a belt conveyor 7 in order to be discharged for further processing.

A first embodiment of the device 4 will now be described in more detail with reference to Figures 2 - 6.

As is apparent from the Figures 2 - 4 the device comprises a rectangular frame 8, in which a flat supporting plate 40 is fixed. To the lower side of the supporting plate there is secured a plate 10 made of a resilient material, e.g. rubber or the like.

A large number of openings 11, circular in the illustrated embodiment, is provided in the plate 10, in such a manner that the central axes of said openings extend perpendicularly to the plate 40. The openings 40 are in communication with a chamber 42 via bores 43 provided in the plate 40, said chamber 42 being bounded by the supporting plate 40 and a cover plate 41 provided, spaced by some distance, above the supporting plate, said cover plate 41 likewise being fixed in the frame 8.

The centre-to-centre distance between the openings 11 may suitably be 10 mm, whilst the diameter of the openings is 7 mm. During operation a sub-atmospheric pressure may be generated in the chamber 42 by means of the fan or the air pump. Valve stems 44 extend through the holes 43. The upper ends of the valve stems 44 are fixed to valves 45 formed by substantially cylindrical bodies. Each valve 45 is secured to the lower end of a bellows 46 located in the chamber 42. The bellows 46 is with its upper end fixed to a disc 47, which is secured to the plate 41 by means of a bolt connection 47.

In the valve stem 44 there is provided a slotted hole 49 (Figure 5), which is in communication, by means of a bore 50 extending through the valve, with the otherwise closed internal room bounded by the bellows 46.

When the device is to be operated a sub-atmospheric pressure will be generated in the chamber 42. In the interior of the bellows 46 there will be an atmospheric pressure thereby, since the interior of the bellows 46 is in open communication with the atmosphere via the slotted hole 49 and the bore 50. As a result the sealing washers 51 provided on the upper ends of the valve stems 44 remain present on the upper side of the plate 40 in order to seal the holes 43.

When the device is placed on one or more objects 15 to be picked up, the valves stems 49 located above the object(s) and the valves 45 with the sealing rings 51 coupled thereto will be forced upwards because the resilient material is pressed down under the influence of the weight of the device, so that the openings 11 located opposite the objects to be picked up will be put into open communication, via the holes 43, with the chamber 42 in which a sub-atmospheric pressure has been generated, and a sub-atmospheric pressure will again be generated in said openings. At the same time a sub-atmospheric pressure is generated in the interior of the bellows connected to the lifted valves 45, since said bellows will also be placed in open communication, via the openings 11 closed by the objects at their bottom sides, the slotted holes 49 and the holes 50, with the chamber 42 in which a sub-atmospheric pressure has been generated. By using this construction the downward force on the forced-up valve 45 will be neglectable.

In those places where no object(s) is (are) located opposite the valve stems 44 the valves 45 remain closed.

When the sub-atmospheric pressure falls out the objects 15 will be released and the resilience of the bellows will force the valves 45 into the closed position illustrated in Figure 4.

With the embodiment illustrated in Figures 7 and 8 the plate 10, consisting of resilient material and having openings 11, is secured to the lower side of a plate 52, in which there is provided a bore 53 which is in open communication with the opening 11. At its end remote from the opening 11 said bore 53 opens, via a conical transition part 54, into a bore 55 having a larger diameter than the bore 53. The upper end of said bore 55 joins up with a bore 56 having an equal diameter, said bore 56 being provided in a plate 57 secured to the upper side of the plate 52. The bore 56 blends, via a conical transition part 58, into a bore 59, whose diameter is at least substantially equal to the diameter of the bore 53.

In the space formed by the coaxial bores 55 and 56 there is present a ball 60 made of rubber, plastic material or the like material, the diameter of said ball being smaller than the diameter of the holes 56 and 55 and larger than the diameter of the holes 53 and 59. The conical transition parts 54 and 58 form valve seats for said ball 60.

The bore 59 opens into a chamber 61 which, besides by the plate 57, is bounded by a plate 62 provided at some distance above the plate 57. In the chamber 61 it is again possible to generate a sub-atmospheric pressure by means not shown.

When using this device the device is first placed on one or more objects 15 to be picked up, as illustrated in Figure 18. Then a sub-atmospheric pressure will be generated in the chamber 61. Near those openings 11 that are not covered by an object to be picked up, air will be sucked in via the opening 11 and the bores 53, 55, 56 and 59, as a result of which there will be an upward air flow, when seen in Figures 7 and 8, in the bores 55 and 56. Said air flow will carry along the ball 60 in upward direction, so that said ball 60 will bed down on the valve seat 58 and close the hole 59, so that it is prevented that air is further sucked in via openings 11 not covered by objects.

Near the covered openings there will be substantially no air flow through the passages 55 and 56, and the ball 60 will rather float, as it were, in the bores 55 and 56, and a sub-atmospheric pressure will be maintained in the openings 11 located opposite the objects 15 to be picked up in order to make it possible for the objects in question to be lifted again.

Claims

1. Device for lifting objects (15) by making use of a sub-atmospheric pressure, whereby the device is provided with a chamber (42) in which a sub-atmospheric pressure can be generated, as well as with a valve (45) located in said chamber and a valve stem (44) fixed to the valve (45), said valve stem (44) extending to a point beyond the chamber (42), through a passage (43) provided in the bottom wall (40) of the chamber (42), and with a bellows-shaped means (46) connected to the valve (45) and the valve stem (44), whereby the lower end of the valve stem (44) is located near an opening (11) surrounded by resilient material (10), which is located at the bottom side of the device, all this in such a manner that the valve (45) and the valve stem (44) can be put from a first position, in which the passage (43) in the bottom wall of the chamber (42) is closed by the valve, into a second position, in which the valve is located spaced from the bottom wall, and in which the chamber (42) is in open communication with the opening (11) surrounded by the resilient material (10), characterized in that the valve (45) is secured to the lower end of the bellows-shaped means (46) disposed in the chamber (42), said bellows-shaped means being retained between the valve (45) and a fastening means (47, 48) located spaced from the bottom wall (40) of the chamber (42), whilst the interior of the bellows-shaped means (46) is in open communication, via a passage (49) provided in the valve (45) and in the valve stem (44), with the opening (11) surrounded by the resilient 25 material (10).

2. Device according to claim 1, characterized in that a plurality of valves (45), with the associated bellow-shaped means (46), are arranged in a common chamber, and that a resilient material (10) bounding a number of openings (11) is provided at the lower side of the bottom wall (40) bounding the chamber.

3. Device according to claim 1, characterized in that one passage (49) is open at the side of the valve stem (44) along at least substantially the entire length of the valve stem.

4. Device for lifting objects by making use of a sub-atmospheric pressured whereby the device is provided with a chamber (61) in which a sub-atmospheric pressure can be generated, said chamber being in open communication, via a passage (59), with a room (56) in which a ball (60) is present, said room being in communication with an opening (11) surrounded by resilient material (10) located at the bottom side of the device, all this in such a manner that when air tends to flow to the chamber (61) via said opening (11) and said room (56), as a result of a sub-atmospheric pressure being generated in said chamber (61), said ball (60) is moved upwards towards the passage (59) in order to close said passage, characterized in that the room (56) accommodating the ball (60) is formed by a bore having a diameter which is larger than the diameter of the ball (60), a further passage (53) connecting to the bottom side of said room, said further passage forming the connection between the bore (56) accomodating the ball and the opening (11) surrounded by the resilient material (10), whilst the ends of the bore form conical seats for the ball.

5. Device according to claim 4, characterized in that said bore is built up of two parts, which are formed in two plates (52, 57) lying on top of each other.

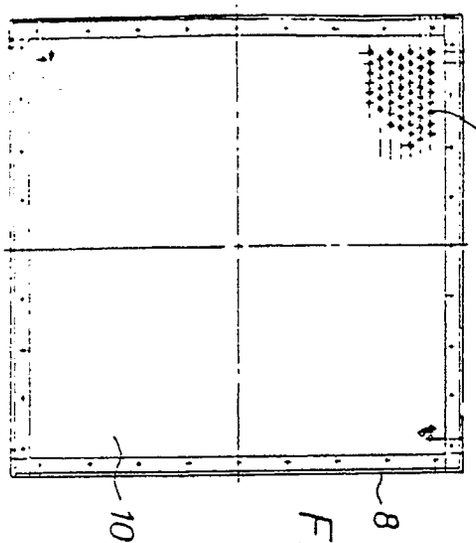


FIG. 2

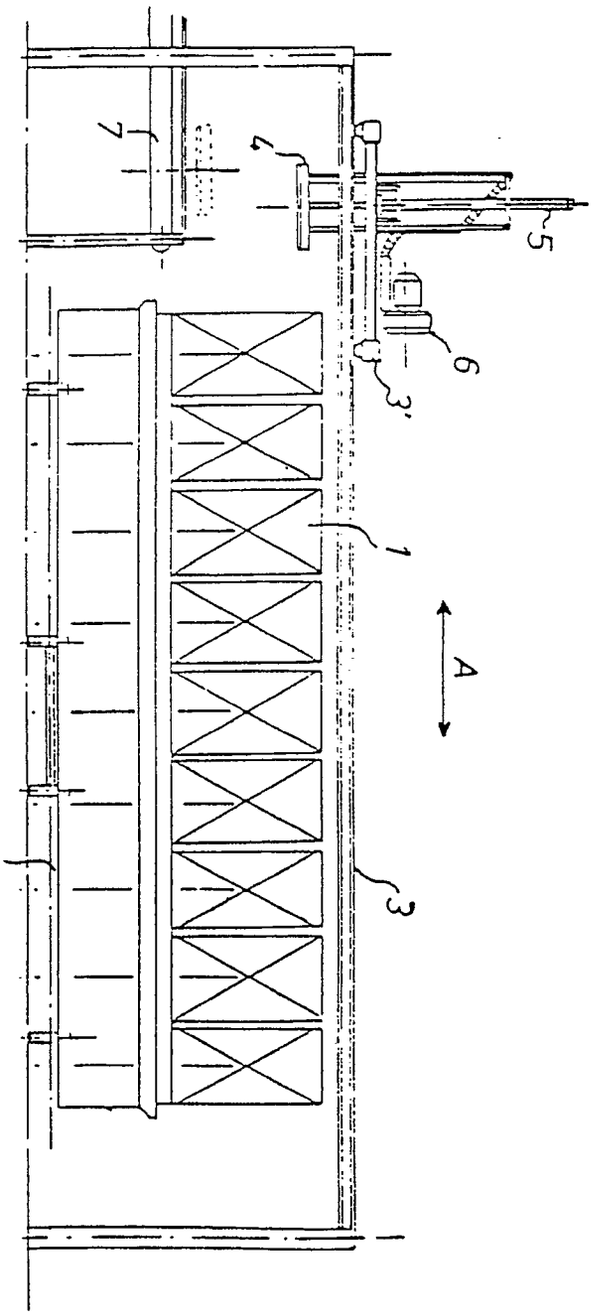


FIG. 1

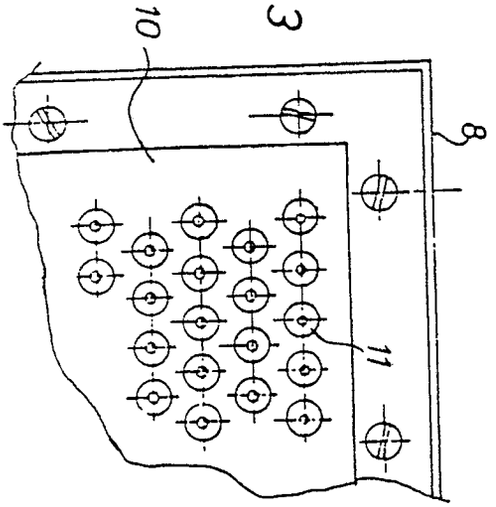


FIG. 3

FIG. 4

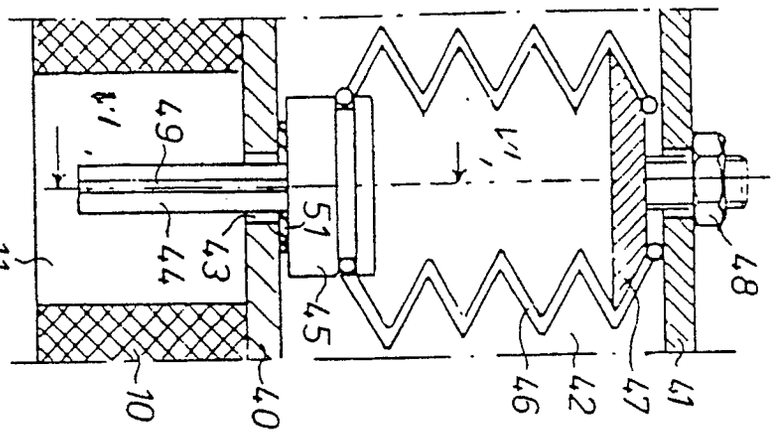


FIG. 6

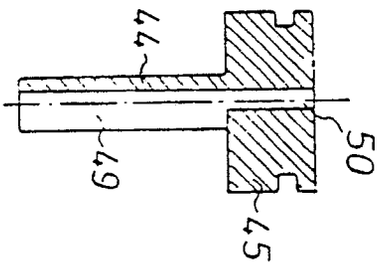


FIG. 5

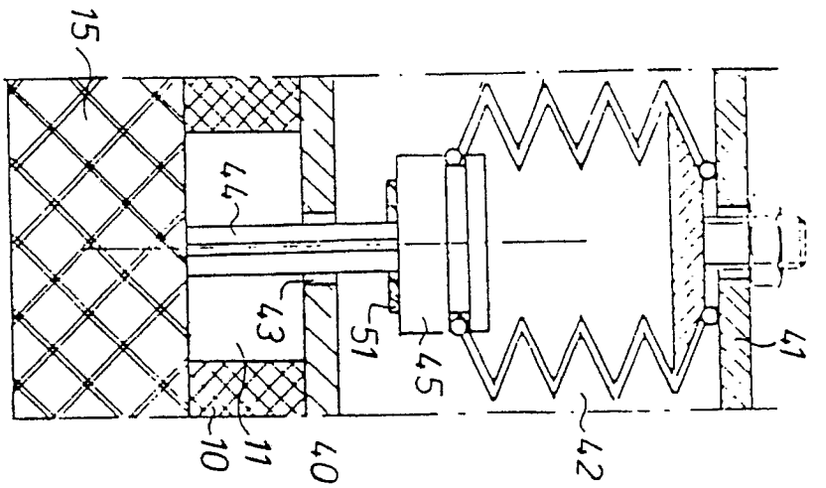


FIG. 7

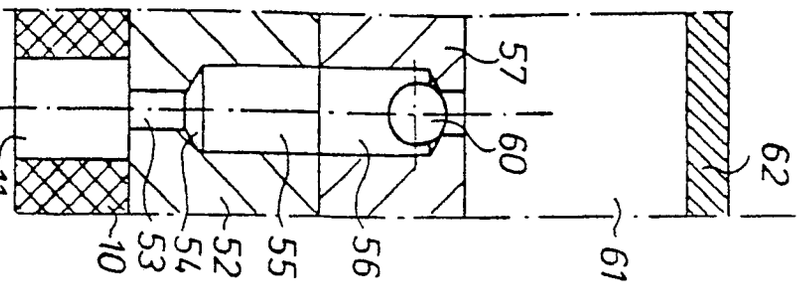
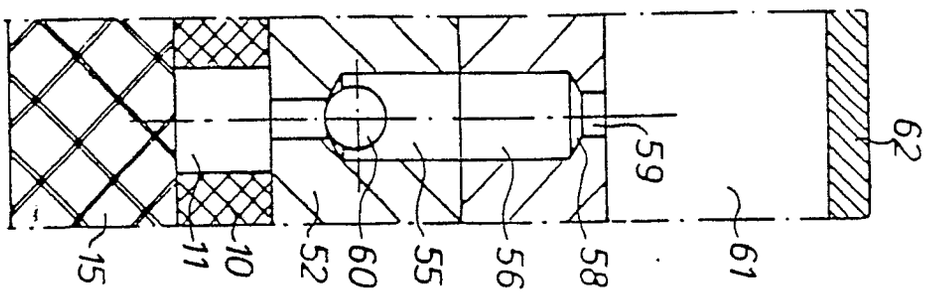


FIG. 8



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EUROPEAN SEARCH REPORT

Application Number

EP 90 20 2713

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A,D	US-A-4 561 687 (BOSTROM) * Complete document *	1	B 66 C 1/02
X	GB-A-1 249 294 (NATIONAL RESEARCH DEVELOPMENT CORP.) * Page 4, lines 98-130; page 5, lines 1-43 *	4	
A	US-A-2 783 018 (LYTLE)		
A	DE-A-3 419 913 (MAX KETTNER VERPACKUNGS-MASCHINENFABRIK)		
A	US-A-3 307 816 (COCITO)		
A	DE-A-3 325 207 (PETER-UHREN)		
A,D	FR-A-2 265 659 (BARBE)		
A,D	US-A-4 787 662 (DEWEZ)		
A	DE-A-2 354 898 (OTHENE INTERNATIONAL HANDEL-MAATSCHAPPIJ)		TECHNICAL FIELDS SEARCHED (Int. Cl.5) B 66 C B 65 G

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	09 January 91	VAN DEN BERGHE E.J.J

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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