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(54) **Retroreflective distributor**

(57) A distributor device 10 includes a container 44, which is arranged in use to contain retroreflective articles. The articles are supplied to the container via a supply line 34 and, in use, are arranged to exit the container through an outlet and down a distributing chute 36 on to a target material. A restrictor 18, which is arranged in the region of the outlet, is operable to determine the extent at which the outlet is restricted and therefore the egress of the articles from the container. The distributor device further comprises an agitator 78, which, in use, assists the articles from moving past the restrictor and also from locking together in the container or supply line. In use, relative movement of the distributor and target material, which includes a pre-laid encapsulant surface, assists in the distribution of a retroreflective deposit that has a different retroreflective character from light emanating from a common source.

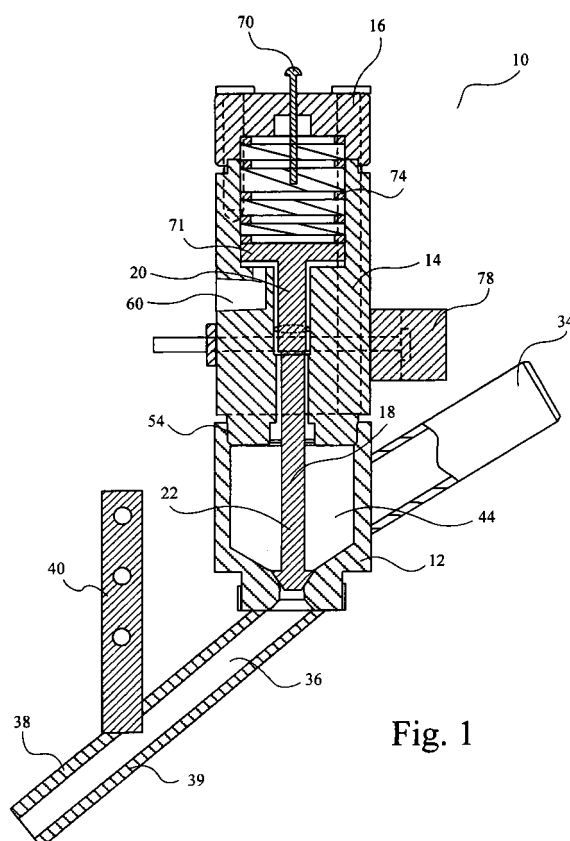


Fig. 1

Description

[0001] The present invention relates to a distributor device for use in distributing beads and, in particular, to distributing beads of a reflective nature in order to create retroreflective surfaces for use as reflective markings and delineators, and high visibility coatings particularly but not exclusively on roads and road signs.

[0002] Highway (road) markings are usually required to be reflective at night. Light emitted from vehicle headlights is reflected back in the direction of the source, i.e. retroreflected, from the surface of the marking or other reflective surface. The retroreflective characteristic of the marking material is typically improved by use of added retroreflective elements or devices. In road markings, spherical glass beads can be added to the surface of the marking during application, or sometimes premixed in the body of the marking material, and by this means the retroreflective characteristics are significantly improved over the natural reflective property of the marking's surface.

[0003] Typical glass beads for this application are substantially uniform spheres with a diameter of approximately 90 - 700 μm (0.09 - 0.7 mm). The spherical beads are spread on to the marking's surface via a distributor device that fires the beads on to the surface. Such firing assists in the lightweight beads partially embedding in the paint or other tacky surface. Beads are fed into a chamber within the distributor under pressure, which forces the beads out of an exit aperture and towards the target material. The beads are agitated within the chamber using a separate supply of atomising air in order to stop the beads grouping together.

[0004] The reflective nature of the glass beads, however, is not sufficiently durable to abrasion and other affects generated by the exposure of the surface to traffic i.e. contacted by vehicle wheels. GB 2 381 615, amongst others, details the use of a retroreflective device comprised of an agglomeration, or cluster, of glass beads to create a durable retroreflective surface. For distribution purposes and according to one aspect of GB 2 381 615, the agglomeration of glass beads forms a single non-spherical cluster approximately 2 mm high and 3.5 mm in diameter.

[0005] Herein any reference to the term cluster includes any agglomeration of glass beads. Such clusters are substantially larger and may be less uniform, and rougher in shape when compared to the singular spherical glass beads previously used. That is partly because of the protrusion of part of the spherical surfaces of the beads from the cluster.

[0006] The roughness and irregular shape of the clusters results in the clusters geometrically locking together in groups of more than one when using a similar device to that described for distributing the singular beads. Furthermore, when the clusters are fired towards the surface the clusters often bounce away from the intended target or become so deeply embedded as a result of their more

significant mass than a single head.

[0007] It is an object of the present invention to attempt to overcome at least one of the above or other disadvantages.

5 **[0008]** According to one aspect of the present invention a distributor device includes a container arranged in use to contain retroreflective articles and an outlet through which, in use, the retroreflective articles are arranged to exit, the device including agitation means arranged, in use, to assist in the retroreflective articles moving past a restrictor in the region of the outlet from the container to fall out of the distributor.

10 **[0009]** The agitation means may be arranged, in use, to inhibit the locking together of retroreflective articles in the region of the restrictor.

15 **[0010]** The agitation means may be an agitator. The agitator may be secured to the device adjacent to the container such as just above the container.

20 **[0011]** The device may include an inlet to the container. The agitation means may be arranged, in use, to inhibit the locking together of retroreflective articles in the region of the inlet.

25 **[0012]** The device may include a supply line arranged to supply retroreflective articles to the container through the inlet. The agitation means may be arranged to inhibit the locking together of retroreflective articles in the supply line. The supply line may be rigid and fast with the container.

30 **[0013]** The restrictor may comprise a valve and may comprise an opening above which is located a member spaced from the opening such that, in use, the retroreflective articles are arranged to move between the member and the opening. The opening may taper downwardly and inwardly. The member may taper downwardly and inwardly.

35 **[0014]** The restrictor may be operable to prevent retroreflective articles from leaving the container by causing relative movement of the member towards the opening of the restrictor.

40 **[0015]** The movement of the member of the restrictor towards or away from the opening may comprise an assembly including a piston section and a needle section. The piston may be moveable between a raised and lowered position, which corresponds to an open and closed arrangement of the outlet aperture. The piston section may include a piston in sealing engagement with side-walls of a cavity. Fluid such as compressed air may be supplied under the piston causing the piston to rise against the action of a resisting means which may be a spring. The fluid such as compressed air may be vented from under the piston seal to enable the piston to fall under the action of the resisting means. The needle section may comprise an extension to the piston shaft and may further include the member of the restrictor on its distal end which may engage with the outlet opening, possibly in a sealing arrangement, when the piston is in the lowered position and is raised clear of the outlet when the piston is in the raised position.

[0016] The device may be secured to transport means. The device may be so secured by a resilient mounting. The device may be secured to transport means at a single part of the device such as the outlet of the device which outlet may comprise a discharge chute.

[0017] Preferably the retroreflective articles consist of an agglomeration of glass beads set in an adhesive and thereby forming a cluster. The clusters may be a non-spherical shape.

[0018] The agitation means may comprise a vibrator that may be held fast relative to the container such that, in use, the vibrations are transmitted through to the container and the retroreflective devices are separated within the container under a vibration force.

[0019] A distributor such as a chute may be arranged proximate the exit aperture in order to guide the retroreflective devices towards the target material. The chute may be adjustable at least in the width of its outlet. The chute may be adjustable in the direction that articles are arranged, in use, to leave the chute either upwardly or downwardly or from side-to-side or both.

[0020] According to a further aspect of the present invention a method of distributing retroreflective articles comprises depositing a plurality of retroreflective articles upon a target surface by agitating retroreflective articles in a container, to cause the retroreflective articles to leave the container past a restrictor and to fall on to the target surface.

[0021] The method may comprise agitating a supply of retroreflective articles to the container.

[0022] The method may comprise supplying compressed air to a vibrator. The frequency and amplitude of the vibrations may be determined by the air pressure supplied.

[0023] The method may comprise increasing or decreasing the restriction afforded by the restrictor such as by opening and closing an outlet of the container. The method may comprise adjusting the limit that the restriction can be increased by.

[0024] Preferably the method may include supplying compressed air under a piston seal to raise the piston between a lowered position and a raised position. The piston may further include a needle with a member such as a bung that engages with the outlet aperture in a sealing arrangement when the piston is in the lowered position and is raised clear of the outlet when the piston is in the raised position.

[0025] The present invention includes a method of using a distributor device when the device is as herein referred to or when the retroreflective articles are as herein referred to.

[0026] According to a further aspect of the present invention, a retroreflective deposit comprises a non-spherical collection of retroreflective articles (which articles may be uniform) attached to an encapsulant surface such that the retroreflective articles have a different retroreflective character from light emanating from a common source.

[0027] Preferably the devices may be orientated in different positions or different orientations within the encapsulant or both.

[0028] According to yet a further aspect of the present invention a method of creating a retroreflective deposit comprises spreading a curable encapsulant layer on the ground and subsequently using a distributor device to deposit a non-spherical collection of uniform retroreflective articles over the encapsulant's surface such that the uniform articles have a different retroreflective character from light emanating from a common source, the encapsulant curing to lock the devices in position.

[0029] The non-spherical condition may be achieved by the articles having a greater extent in one direction than another.

[0030] The present invention includes any combination of the herein referred to features or limitations.

[0031] The present invention can be carried into practice in various ways but several embodiments will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a cross-sectional side view of a distributor device in a first closed position.

Figure 2 is a cross-sectional side view of the distributor in a second open position.

Figure 3 is a perspective view of the distributor device attached to a vehicle.

Figures 4 and 5 are side perspective views of the main body and middle section of the distributor respectively.

Figure 6 is a side perspective view of the top section, spring, and stopper assembly.

Figure 7 is a side view of the cluster deposit in the encapsulant material, and

Figure 8 is a view of a cluster.

[0032] As shown in figure 1, the preferred embodiment of a distributor device 10 includes: a main body 12; a mid section 14; a top section 16; and an operable means such as a stopper assembly 18, which is comprised of a piston section 20 and a needle section 22. The stopper assembly is arranged such that it is moveable between a closed position, figure 1, in which the needle blocks an outlet such as an exit aperture 24, and an open position, figure 2, in which the needle is raised clear of the exit aperture 24. As shown in figure 3, the distributor device 10 is mounted to a suitable vehicle 28 and at a height spaced apart from the target surface 30. When in use, the vehicle is driven in the direction of the arrow and cluster 32 are fed into the distributor device 10 down a feed pipe 34 so that when the needle is raised in the open position a

spatial array of clusters 32 is deposited on the target material. The vehicle deposits the target material just in advance of the clusters being deposited. The distributor device is described further herein.

[0033] The retroreflective cluster devices are comprised of an agglomeration of glass beads set in an adhesive and formed into a non-spherical solid shape of uniform consistency. Figure 7 shows, in an exaggerated manner, the "donut" shape of the clusters. Figure 8 shows the clusters with the beads protruding from the resin that binds them together. The shape is comprised of a disk of generally circular cross-section and a height slightly less than the radius of the cross-section and with a slight recess in the middle of the disc. The surface of the clusters is not smooth as it comprises a mixture of beads 26 and adhesive 27. The protrusion of part of the surface of embedded beads that can cause interlocking of clusters is seen in Figure 8.

[0034] Figure 4 shows the main body 12, which includes a chute section 36. The chute 36 extends downwardly and forwardly from the exit aperture 24 and a top plate 38 spaced from a bottom plate 39. The plates are substantially parallel and enable at least one cluster 32 of the largest tolerance to pass between them. The chute includes sidewalls which are located to extend between the two plates 38,39 and are spaced apart either side of the exit aperture such that clusters can not egress from the side of the chute and further, can only exit the chute from its end farthest from the exit aperture 24. It should be clear that the distance the sidewalls are spaced apart determines the maximum extent of the lateral cluster distribution on the target material.

[0035] The sidewalls could be fixed permanently in position between the plates with different chutes being attached to the main body, using any well-known method, in order to effect changes in the width of the cluster deposit. Alternatively the sidewalls could be moveably mounted, using any well-known manner, such that their spaced apart distance may be controlled in order to control the width of the cluster deposit on the target material.

[0036] A mounting bracket 40 is attached to a top surface of the top plate 38 and is comprised of an upwardly extending bar. Referring back to figure 3, the mounting bracket 40 includes an adjustable connection system that co-operates with a receiving mounting bracket 42 that is attached onto the vehicle 28. The connection system comprises, although is by no means limited to, a nut and bolt arrangement which passes through holes created in both the brackets and that is tightened to hold the brackets fast to each other. The brackets are separated by a damper comprising a large rubber washer 43, which is sufficient to absorb vibrations that would otherwise be transmitted through the connection and thereby risk fatigue in the connection. The connection system is adjustable using a plurality of holes spaced along the length of each bracket. The chute may be adjustable from side-to-side or up and down.

[0037] Referring again to figure 4, the main body fur-

ther includes a feed pipe 34, a substantially cuboid section 50 comprising containing means such as a chamber 44, and support rods 46. The feed pipe 34 is attached to the trailing side of the main body and surrounds an inlet to the chamber such as a hole 48, which extends through the wall of the main body and into the chamber 44 such that clusters 32 can flow down the feed pipe under gravity and into the chamber 44. A second end of the feed pipe 34 is engageable with a conduit supplying clusters from a main tank (not shown). The conduit could comprise a flexible feed tube 48, which fits over the second end of the feed pipe and is secured using a jubilee clip or, alternatively, may comprise any other known conduit system such as a feed hopper of wide cross section.

[0038] The cuboid section 50 contains a borehole extending normal from the top surface and substantially through the cuboid section. The bore does not continue through the cuboid section and therefore forms the chamber 44. As shown in figures 1 and 2, the bottom of the bore is angled in order to funnel towards the exit aperture, which aids the flow of clusters out of the chamber. The exit aperture is comprised of a smaller diameter bore with co-aligned axis to the partial bore and extends from the bottom of the chamber through to the underside of the cuboid section.

[0039] The two support rods 46 extend upwardly from two opposing corners of the cuboid section 50 and are attached by a first end region of the rods using any well-known method. A second end region of the rods 47 is threaded leaving the central section substantially smooth about which the mid section and top section can be assembled.

[0040] The mid section 14, as shown in figure 5, is comprised of a body with a square cross-section of similar size to the main body 12. The mid section 14 includes two holes 52 extending the length of the body and positioned in two opposite corners such that the two support rods 46 that are affixed to the main body may engage with the holes 52 to align the centre axis of the mid section 14 with the centre axis of the main body 12. A lower face of the mid section includes a raised circular boss 54 that engages with the bore forming the chamber 44. A top face of the boss 54 abuts with a step formed in the sidewalls of the chamber.

[0041] A top face at opposite ends to the lower face includes a raised ring 55, which engages with the top section 16. The top face further includes two upwardly extending small support rods 56, which are positioned in two opposing corners of the square body that do not already contain the holes 52. The small support rods 50 are attached to the mid section using any well-known method. A second end region 57 of the support rods 56 is threaded.

[0042] A stepped bore 58 extends between the lower face and the top face of the mid section. The stepped bore 58 has a smaller diameter extending from the lower face, through which the stopper assembly 18 may pass, and a larger diameter extending from the top face.

[0043] As shown in figures 1 and 2, a hole 59 initially extends from a side face of the mid section towards the centre axis and normal to the side face before turning approximately ninety degrees to extend upwardly exiting through an exit aperture 60 in the step of the bore 58. The side face includes a receptacle in alignment with the hole 59 for receiving a connector of a compressed air hose 61. A pump (not shown) operating at the opposite end of the hose 61 can be either in a forward arrangement in which compressed air egresses from the exit aperture 60 or in a neutral arrangement in which air is vented from the hose 61.

[0044] As shown in figure 6 the top section 16 has a similar square cross-section to the main body and mid section and includes four holes 62 extending through the top section. The holes 62 are positioned in all four corners such that they engage with the two support rods 46 extending upwardly from the main body 12 and the two small support rods 56 extending upwardly from the mid section 14 in order to align the central axis of the top section to that of the mid section and main body. Nuts 64, seen in figure 3, tighten on the threaded ends 47 and 57 of the support rods 46 and 56 and abut an upper face of the top section, which brings the main body, mid section, and top section into compression and thereby locks them in fixed engagement with each other.

[0045] A bottom surface of the top section includes a stepped bore 66, which extends partially through the top section. The step in the bore is such that the first diameter receives the raised ring 55 of the mid section 14 such that the top face of the raised ring abuts with the step in the bore 66. The second diameter of bore 66 is substantially the same and aligned with the large diameter bore in the mid section. The two combine together to create an upper cavity 68.

[0046] The top section further includes a threaded tap formed through the top face and into the cavity 68. A bolt 70 is tightened / loosened in the tap to determine the extent at which it protrudes into the cavity. A locking nut arrangement (not shown) is used to fix the bolt in place in order to stop the depth of the bolt from deviating once set.

[0047] The stopper assembly 18 is arranged within the internal bores of the top section, mid section, and main body. The piston section 70 includes a piston seal 71 that is in sealing engagement with the cavity 68 and can move up and down within the cavity. A piston shaft 72 extends downwardly from the piston seal and in to the smaller diameter of the stepped bore 58. A circular sealing ring 73 is housed in a notched radial groove on an end region of the piston shaft farthest from the piston seal 71. The sealing ring 73 forms an airtight seal between the piston rod and the smaller diameter of the stepped bore 58.

[0048] A spring 74 positioned between the top of the piston seal and the internal top face of the cavity 68 such that it urges the piston seal downwardly towards a position shown in figure 1. When the compressed air pump is in the forward position and compressed air egresses

from the exit aperture 60 in the step of bore 58, the air pressure forces the piston upwardly against the action of the spring 74. The piston stops when the piston seal 71 abuts the end of the bolt 70, figure 2. The length of the piston stroke can thereby be determined by controlling the depth that the bolt 70 protrudes into the cavity, as previously described. A small vent hole (not shown) extends through the wall of the cavity 68 to prevent pressure build up from blowing the seals. When the compressed air is removed and vented, the spring 74 returns the piston 20 to the closed position.

[0049] A needle section 22 extends from the distal end of the piston shaft 72 farthest from the piston seal 71. The needle 22 includes a bung 76 attached to the farthest distal end of the needle from the sealing ring. When the piston is in the closed position the bung mates with the exit aperture 24 in the bottom of the chamber 44 such that it closes the exit aperture. When the piston is raised, the bung is also raised such that the exit aperture is open with the height of the raised position being determined by the extent that the bolt 70 protrudes with the cavity.

[0050] An agitation means such as a vibrator unit 78 of any well-known type is attached to the outside of the mid section 14 using any well-known method so that the unit is fixed fast to the mid section. The vibrator 78 is actuated by supplying compressed air, via hose 79 (shown in figure 3), to the unit and causes the unit to vibrate at varying frequencies and amplitudes dependant on the air pressure supplied. The vibration of the unit 74 is transmitted through the mid section 14 and into the main body 12. The vibration is further transmitted through the walls of the chamber 44 and feed pipe 34, which effects to tease the clusters 32 apart to ensure they do not group or lock together thereby reducing the risk of blockages in the feed pipe or localised densities of multiple clusters forming in the deposit on the target material.

[0051] During use of the distributor device 10, clusters 32 are fed under gravity from the main tank and into the chamber 44 via the feed pipe 34. When the chamber is full the flow of clusters may cease or may be continuous. The vehicle is driven along following the path of the required deposit of retroreflective material. An encapsulant layer is first deposited on the ground from a spreading assembly mounted forwardly on the vehicle to the distributor device. When the deposit of retroreflective material is required to start, the compressed air supply to the piston is turned on and the piston raised, which opens the exit aperture 24. Simultaneously the vibration unit 78 is actuated or alternatively the vibration unit is permanently actuated. The unit 78 vibrates the chamber teasing the clusters apart so that they individually flow into the chamber, through the chamber and out of the exit aperture and down the chute, falling on the encapsulant layer (target material) under gravity. The clusters are caught by the encapsulant material and become permanently held in place once the encapsulant sets.

[0052] The vibration unit further transmits vibrations along the feed pipe to ensure the clusters do not lock

together in the pipe and block the flow of beads into the chamber. When the vehicle reaches the end of the required retroreflective material deposit, the compressed air supply to the piston 20 is vented and the exit aperture 24 closed by the bung 76 under the action of the spring 74 and the cluster deposit thereby ceases.

[0053] Figure 7 shows a side view of the encapsulant material 80, which is first deposited on the ground 81 or road sign, and includes a deposit of retroreflective cluster devices 32 on a top surface of the encapsulant.

[0054] The encapsulant 80 is a setting material that adheres readily to the contact surface 81. The clusters are deposited using the aforementioned distributor device 10 and whilst the encapsulant is in its liquid state. The clusters are therefore partially embedded in the encapsulant, although a substantial part of the cluster protrudes proud from the encapsulant. As the clusters are more substantial than a single bead they bed well in to the encapsulant when simply dropped on to the encapsulant. Once the encapsulant is cured, the clusters are held fast in the encapsulant due to the setting material interlocking with the embedded portion of the cluster.

[0055] The distributor device 10 ensures the clusters 32 are deposited singularly on the encapsulant's top surface. A substantial number of the deposited clusters are orientated with their central "donut" axis extending upwardly from the encapsulant's surface such that the portion of the cluster that is embedded in the encapsulant includes the top or bottom surface of the cluster.

[0056] Additionally, the remaining fraction of clusters are orientated with their central axis extending between being parallel with the encapsulant's surface and being normal to the surface such that the portion of the cluster embedded within the encapsulant does not include the entirety of either the top or bottom surface.

[0057] The resulting retroreflective deposit of non-circular, uniform particles therefore includes clusters 32 that are orientated at varying angles to the encapsulant material 80. The retroreflective clusters reflect light from a source such as a vehicles headlight. Due to the varying orientation of the uniform cluster particles, they exhibit different retroreflective characteristics from light coming from a common source. Thus the major surface of some clusters will face a driver from a distance with the angle of that major surface to the driver changing as the driver approaches with the major surface of other clusters then coming to face the driver as the driver gets even closer.

[0058] The distributor device of the present invention is advantageous as it enables a deposit of singularly spaced retroreflective cluster devices to be spread over an encapsulant material without the clusters grouping or locking together in either the feed pipe, which would thereby create blockages, or in the cavity, which would thereby create groups of more than one cluster in the deposit. The deposit is further advantageous as it enables multiple uniform clusters, which are deposited on an encapsulant material, to display a different retroreflective characteristic from light coming from a common source.

[0059] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0060] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0061] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

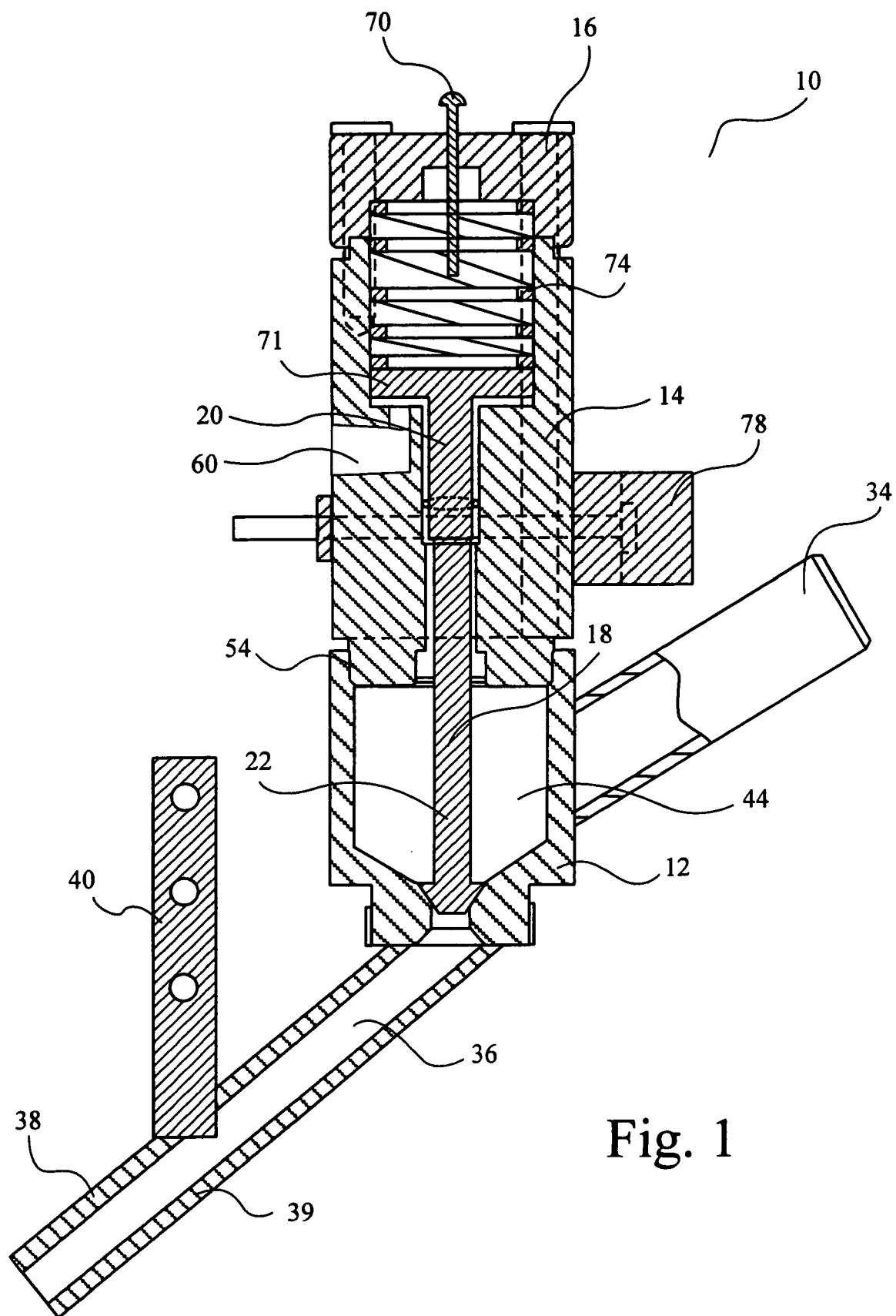
Claims

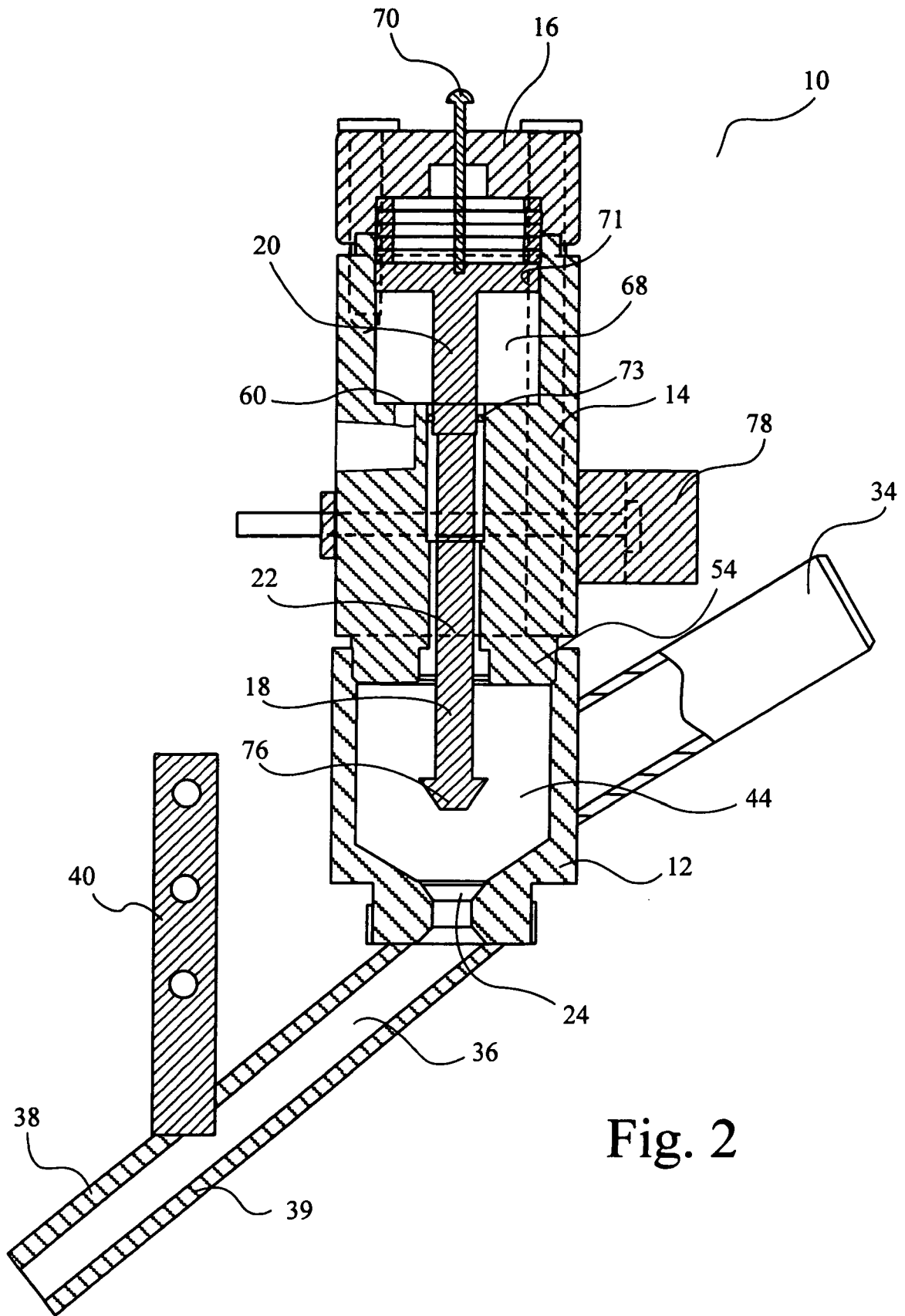
1. A distributor device (10) including a container (44), which is arranged in use to contain retroreflective articles (32), and includes an outlet (24) through which, in use, the retroreflective articles are arranged to exit, the device further including agitation means (78) arranged, in use, to assist in the retroreflective articles moving past a restrictor, which is arranged in the region of the outlet from the container (44), in order to fall out of the container.
2. A distributor device as claimed in Claim 1 in which the agitation means is secured just above the container.
3. A distributor device as claimed in any preceding Claim, in which the agitation means comprises a vibrator that is held fast relative to the container such that, in use, vibrations are transmitted through the container and the retroreflective articles are separated within the container under a vibration force.
4. A distributor device as claimed in Claim 3 in which the container is arranged to be resiliently mounted on a carrier (28) of the device.
5. A distributor device as claimed in any preceding claim, in which the agitation means is arranged, in use, to inhibit the locking together of the retroreflective articles in the region of an inlet to the container.
6. A distributor device as claimed in any preceding claim, in which the device includes a supply line (34) arranged to supply retroreflective articles to the container and the agitation means is arranged to inhibit

the locking together of the retroreflective articles (32)
in the supply line (34).

7. A distributor device as claimed in any preceding claim, in which the restrictor is operable to prevent retroreflective articles from leaving the container by causing relative movement of a member towards an opening of the restrictor. 5
8. A distributor device as claimed in Claim 7, in which the movement of the member of the restrictor towards or away from the opening comprises an operable assembly including a piston section and a needle section. 10
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9. A distributor device as claimed in Claim 8, in which the needle section comprise an extension to the piston shaft.
10. A distributor device as claimed in any preceding claim including a chute (36) arranged to guide retroreflective articles away from the container. 20
11. A distributor device as claimed in Claim 10 in which the chute is adjustable in width. 25
12. A distributor device as claimed in Claim 10 or 11 in which the device is secured to transport means at a single part (40) of the device comprising part of the chute. 30
13. A distributor device as claimed in any preceding claim, in which the retroreflective articles consist of an agglomeration of glass beads set in an adhesive and thereby forming a cluster with part of the periphery of at least some of the beads projecting from the adhesive. 35
14. A method of distributing retroreflective articles comprises depositing a plurality of retroreflective articles upon a target surface by agitating retroreflective articles in a container, to cause the retroreflective articles to leave the container past a restrictor and to thereby be distributed. 40
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15. A method as claimed in Claim 14 comprising a vibrator secured to the container causing the agitation with a distributing chute being connected to a carrier by resilient means (43) which cause the chute to move towards and away from the carrier as the container is agitated and with the container not being otherwise connected to the carrier. 50

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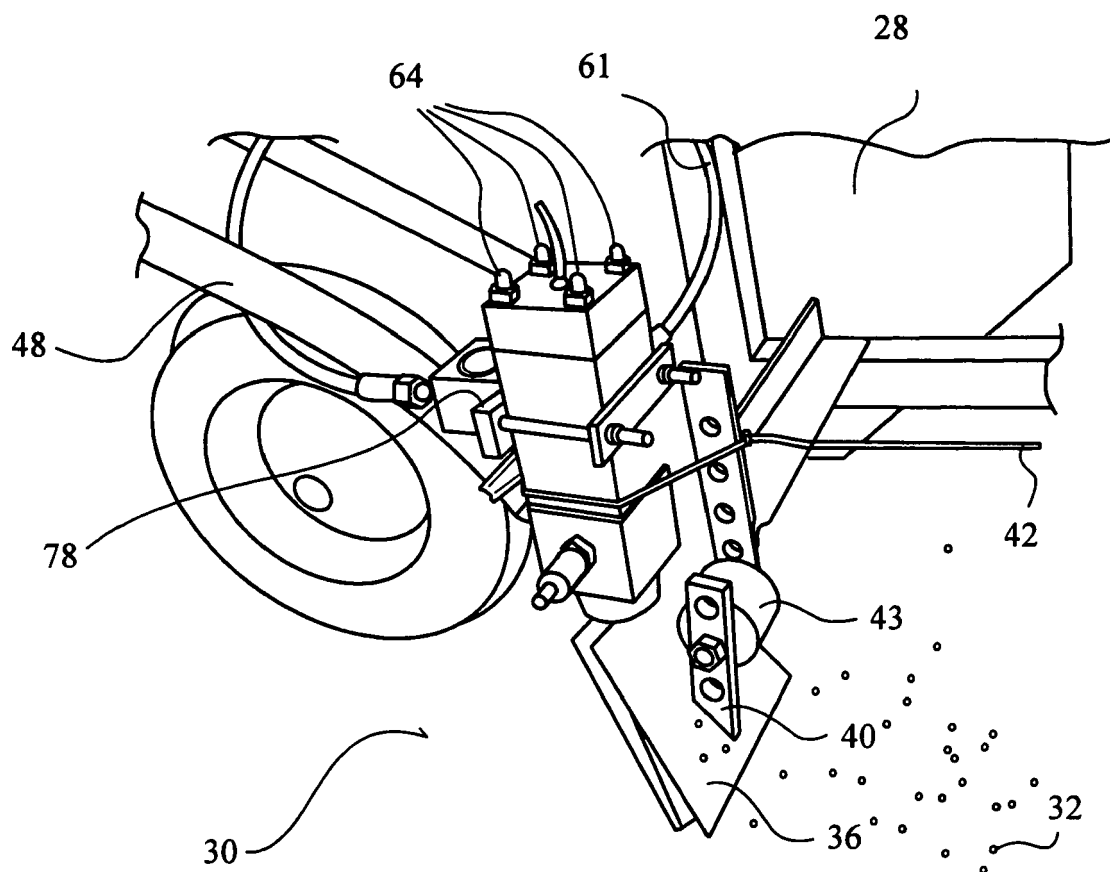


Fig. 3

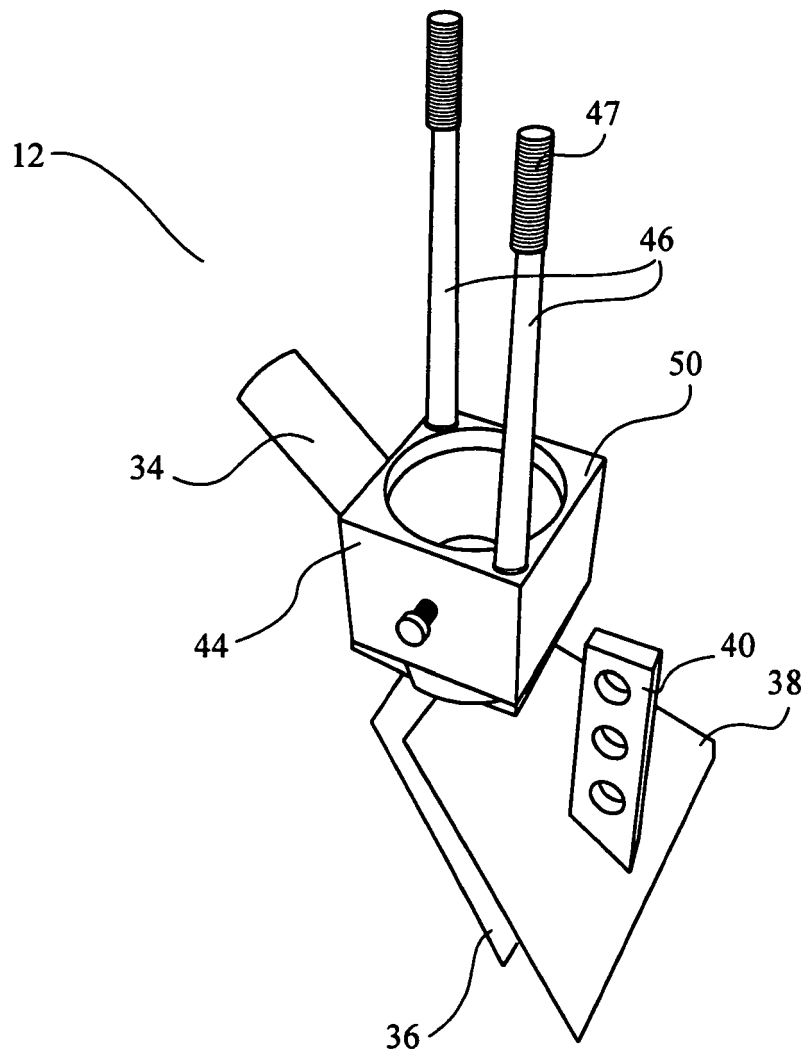


Fig. 4

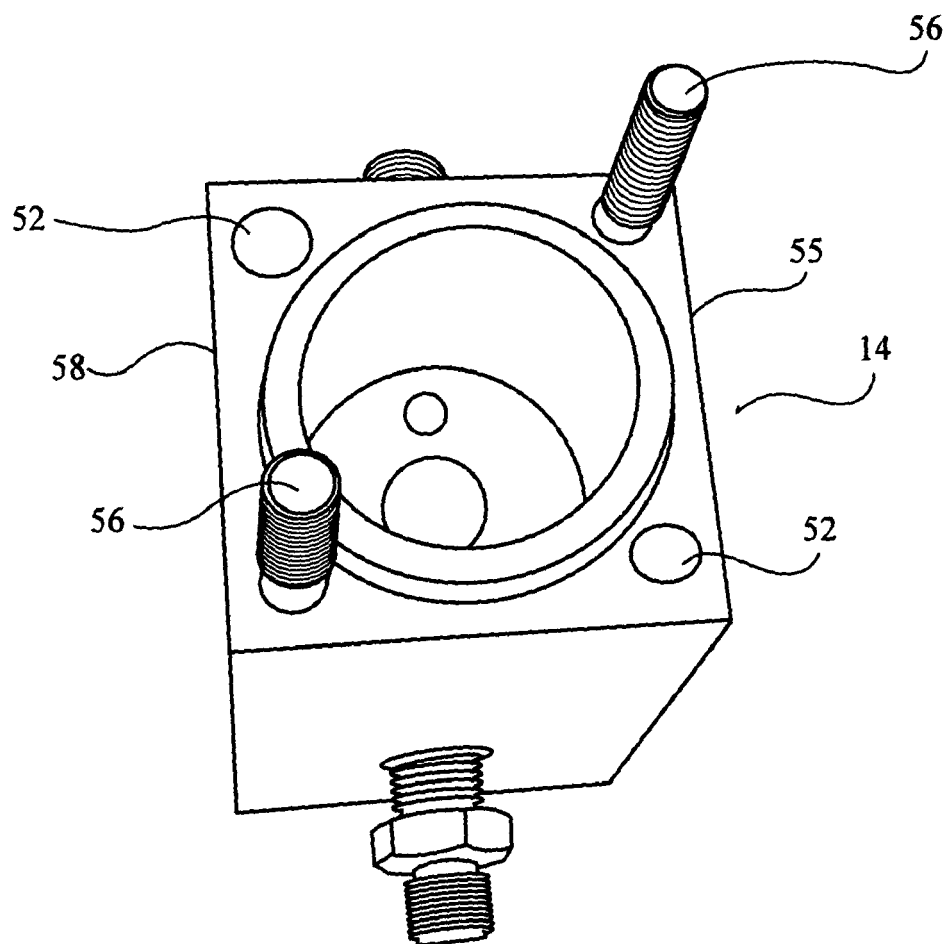


Fig. 5

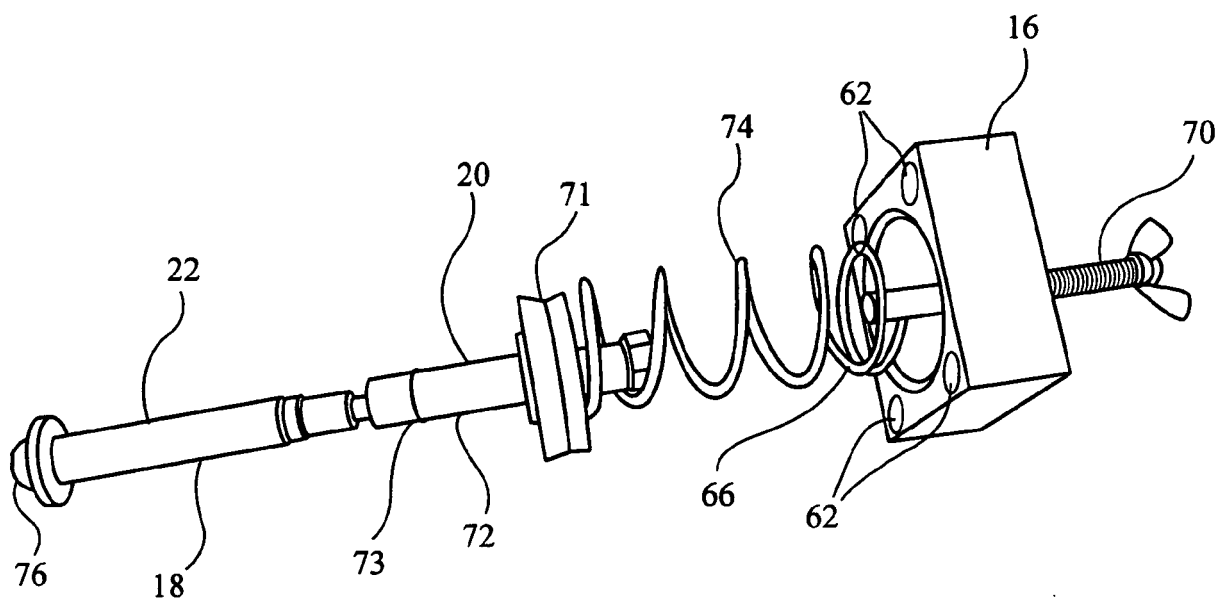


Fig. 6

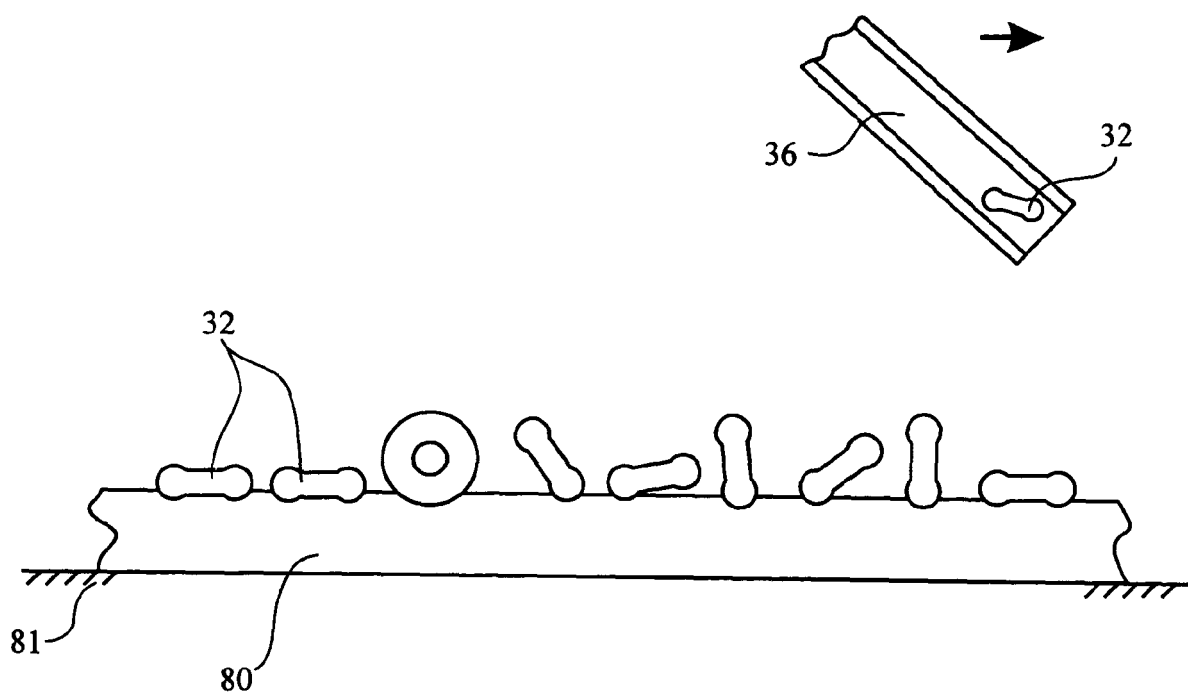


Fig. 7

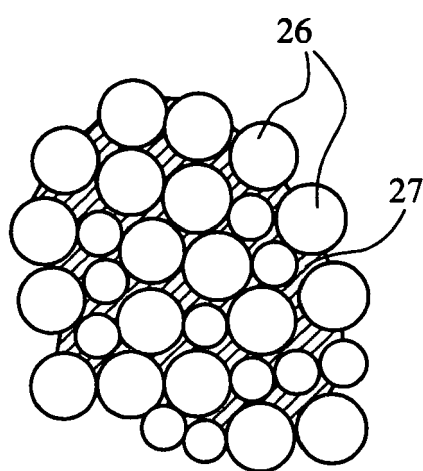


Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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