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(54) **Fluid applicator head.**

(57) The present invention provides a fluid applicator head (10, 101) in which fluid is to be ejected through a plurality of nozzle orifices (17, 109) notably by means of pressure pulses or by means of valve means (16, 104) which control the flow of fluid through the nozzle orifices, which applicator head can be flushed out by passing a flushing fluid through the nozzle orifices, characterised in that the applicator head is adapted to be moved from a first, operative position at which it can apply droplets of a fluid to a substrate opposed to the nozzle orifices, to a second, flushing position at which the nozzle orifices engage with a flushing member (13, 120) incorporating fluid flow conduits (51, 52, 53, 121, 122). whereby flushing fluid can be caused to flow through the nozzle orifices (17, 109) or through conduits (20, 21, 22, 108) associated therewith.

The invention also provides a method for applying a fluid in droplet form to a substrate which comprises using an applicator of the invention and moving the applicator head from its operative position to its flushing position and passing a flushing fluid through the nozzle orifices when it is desired to flush out the applicator head.

Fig.1.

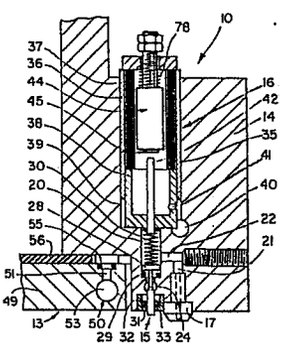
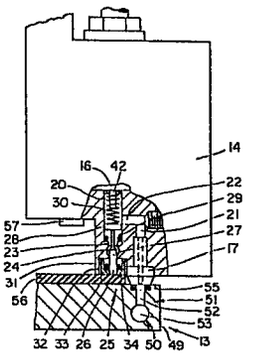


Fig.2.



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Description

FLUID APPLICATOR HEAD

The present invention relates to a fluid applicator head, notably to a drop on demand jet printing head assembly incorporating a means for flushing ink or other fluids from the nozzle orifice, and to a method for operating such a head.

BACKGROUND TO THE INVENTION

With drop on demand ink jet types of fluid applicators, ink, adhesive or other fluid is ejected from a fixed array of nozzles in a print head. The flow of fluid through the nozzles can be caused by exerting a pressure pulse on the fluid immediately upstream of the nozzle orifice, for example when a wall of the print head is caused to flex under the action of a piezoelectric crystal. Alternatively, the flow of fluid can be controlled by actuating valves, eg. electromagnetic valves, in the fluid flow lines between a reservoir under pressure and the nozzles in the print head. The pattern in which the droplets are deposited on a substrate moving transversely past the nozzles is determined by the sequence in which the nozzles or their valves are operated. For convenience, such applicator heads will be denoted herein as drop on demand printer heads.

However, the fluid often contains solvents or other carrier fluids which readily evaporate or, in the case of adhesives, is a composition which contains ingredients which tend to separate out from the composition if it is allowed to dry out or to stand for any length of time. As a result, solids tend to separate out from the fluid and to obstruct the nozzle orifices or the conduits serving them. This causes problems whenever the operation of the applicator head is interrupted for any length of time.

In order to reduce problems with drying out of the fluid at the nozzle orifices, it has been proposed to provide the applicator head with a pad or other means which is used as a cap to cover the nozzle orifices when the applicator head is not in use. However, the pad often adheres to the face of the applicator head and such a device does not overcome the problem of deposition of solids from the fluid within the applicator head during standing.

It is has been proposed to flush out that part of the applicator head immediately upstream of the nozzles when operation of the head is interrupted for a long time, eg. for more than about eight hours as at the end of a day's operation or over a weekend. This flushing removes fluid which remains in the applicator head, so as to reduce the build-up of deposits at the nozzle orifice or in the conduits leading to the orifice. The flushing fluid can be fed through the whole of the applicator head, but this can cause problems with dilution of the fluid to be applied in a subsequent operation of the head. It has therefore been proposed to feed the flushing fluid to the applicator head through a branch feed tube debouching substantially normally through a side wall into the conduit feeding fluid to the nozzle orifice, for example into the chamber immediately upstream of the nozzle orifice.

In the prior proposals for flushing out the applicator head, the head has remained static with the desired fluids fed to it by suitable ducting. However, this requires the use of some means for collecting the flushing fluid as it leaves the applicator head so that it will not reach the substrate onto which ink or other fluid is to be applied at a later stage, yet this collection means must not prevent the ink or other fluid reaching the substrate when operation of the applicator head is re-commenced. Furthermore, the flushing is not always successful in removing the more tenacious deposits from the applicator head. We have also found that droplet formation at the nozzle orifice during operation of the applicator head can be deleteriously affected by the presence of the flushing fluid ducts in the applicator head.

We have now devised an applicator head assembly which reduces the above problems.

SUMMARY OF THE INVENTION:

Accordingly, the present invention provides a fluid applicator head in which fluid is to be ejected through a plurality of nozzle orifices, notably by means of pressure pulses or by means of valve means which control the flow of fluid through the nozzle orifices, which applicator head can be flushed out by passing a flushing fluid through the nozzle orifices, characterised in that the applicator head is adapted to be moved from a first, operative position at which it can apply droplets of a fluid to a substrate opposed to the nozzle orifices, to a second, flushing position at which the nozzle orifices engage with a flushing member incorporating fluid flow conduits, whereby flushing fluid can be caused to flow through the nozzle orifices or through conduits associated therewith.

Preferably, the flushing position comprises a member against which the areas of the applicator head adjacent the nozzle orifices seat and through which flushing fluid can be caused to flow in either or both directions through the nozzle orifices. In a particularly preferred form of the applicator head of the invention, the applicator head is reciprocated and/or pivotted to move into register with a flushing member having a surface adapted to receive the nozzle outlet face of the applicator head in a sealing engagement and having conduits therein to receive flushing fluid from the nozzle orifices and/or from a source of flushing fluid.

The invention also provides a method for operating an applicator head of the invention which comprises moving the head from its first position to its second position when it is desired to flush out the applicator head and causing flushing fluid to flow through the nozzle orifices.

As indicated above, the presence of the flushing fluid ducts within the applicator head can deleteriously affect droplet formation at the nozzle orifice. Surprisingly, we have found that if the flushing fluid is introduced by means of an orifice in a duct which

intersects and passes across the conduit feeding fluid to the nozzle orifice, problems with droplet formation are reduced.

Accordingly, from a further aspect, the present invention provides a fluid applicator head of the invention having a first fluid conduit whereby fluid can be caused to flow through a nozzle orifice located terminally upon the fluid flow conduit, and having a second fluid duct which intersects the first conduit and is provided with an aperture through which fluid from the second conduit can flow into the first conduit, said aperture being located within the first conduit and being directed substantially along the intended line of flow of fluid through said first conduit.

Preferably, the second fluid duct is provided as a substantially cylindrical tube which passes diametrically through the first conduit and the aperture for the second fluid is located substantially upon the longitudinal axis of the first duct. It is particularly preferred that the second duct have a plan area normal to the line of flow of fluid through the first conduit which is from 40 to 95% of the cross-sectional area of the first conduit at that point. It is also preferred that the second duct present a rounded surface to the flow of fluid through the first conduit.

The applicator head of the invention can be applied to a wide range of types of drop on demand applicators, including those in which the fluid is ejected from the nozzle by the action of a transducer, such as a piezoelectric crystal, acting directly on the ink itself or on a flexible or deformable wall of a chamber in fluid flow communication with the nozzle orifice to generate a pressure pulse within the fluid to cause a droplet to be ejected through the nozzle orifice. However, the invention is of especial use with drop on demand applicator heads in which the fluid flow to the nozzle orifice is controlled by the action of a valve means, notably a solenoid valve, in the pressurised fluid flow line to the nozzle orifice. For convenience, the invention will be described hereinafter in terms of such an applicator head.

The fluid to flow through the applicator head can be selected from a wide range of organic solvent- or water-based visible ink compositions; from compositions based on a thermoplastic carrier medium such as a meltable wax or resin; and compositions containing other indicator media, for example UV fluorescent materials. The invention can also be applied to water or solvent based adhesive compositions, notably those using polyvinylacetate polymers or co-polymers. For convenience the present invention will be described hereinafter in terms of the use of an aqueous adhesive composition containing a PVA resin, notably those which are quick drying or which tend to form deposits if stood for long periods.

In the present invention, the applicator head comprises a conduit through which adhesive is fed to the nozzle orifice. Typically, this conduit will be a bore within a solid block, for example one machined from aluminium, brass or stainless steel. However, the invention can be applied to structures in which the conduit is provided as a tube, eg. a stainless steel tube, linking the valve mechanism to the nozzle. In the case where the conduit is a bore within a solid block, the bore can be one connecting a valve chamber in which the valve mechanism acts to open or close the outlet to the chamber serving the bore, with the nozzle orifice directly. However, specific features of the design of the block for a given application may require that the bore follow a tortuous path and/or include one or more intermediate chambers. For convenience, the invention will be described in terms of the use of a bore which feeds fluid directly from the valve mechanism or chamber to the nozzle outlet.

The bore forming the conduit linking the valve to the nozzle outlet is preferably a simple circular cross-section bore which has been drilled or otherwise formed within the applicator head block. If desired the conduit walls can be given a surface coating of a material not readily wet by the fluid in order to reduce the risk of deposition of material upon the walls of the conduit. Alternatively, the applicator head block can be formed in part or wholly from such a material, eg. polytetrafluorethylene.

As indicated above, the valve mechanism is preferably a solenoid valve mechanism. This can be located wholly within the applicator head and can utilise bores within the head to provide some of the bores required for the proper operation of the valve mechanism. However, it is preferred that the valve mechanism be demountable as a unit from the applicator head for ease of servicing and/or replacement. Thus, the applicator head will usually comprise a valve chamber having means for receiving the valve mechanism in sealing engagement therewith and having a fluid feed bore or bores for feeding fluid to the inlet to the valve mechanism, the outlet from the valve being connected to the conduit serving the nozzle orifice. Typically, the feed will incorporate the use of a manifold for distributing the flow of fluid between several valve mechanisms, each serving a single nozzle orifice or set of orifices. Thus, in a preferred construction, the applicator head incorporates a fluid feed bore connecting each of the valve mechanisms and serving as the manifold. Such a bore typically runs longitudinally along the applicator head block with the conduits feeding the nozzle orifices running transversely from the valve chambers. The longitudinal bore has connections to each of the chambers in which the valves are located.

In a particularly preferred construction, the applicator head is made from an elongated block of metal having a longitudinal bore acting as the fluid inlet and manifold. This bore intersects a number, typically five to sixteen, transverse bores which provide recesses into which solenoid valves seat with their inlet ports exposed to the recesses to receive fluid from the bore. The outlet ports from the valves are in sealing engagement with transverse conduits leading through the head block, one to each nozzle orifice served by a given valve. The longitudinal bore is connected by flexible pipes or other suitable means to a source of fluid adhesive under pressure.

The applicator head is provided with means for feeding flushing fluid into the bores serving the nozzle orifices. The flushing fluid may be caused to pass through the whole of the adhesive flow path

through the applicator head. However, it is preferred that it pass through only that area of the flow path adjacent the nozzle orifice, for example through the valve chamber, the nozzle orifice and the conduit connecting them. Preferably, the flushing fluid is fed from an external source through bores within the applicator head block into the valve chambers or into the bores connecting the chambers to the nozzle orifices. The flushing fluid is conveniently fed from a pressurised source via flexible pipes or the like which can accommodate the movement of the head between its operative and flushing positions. If desired, the head can be connected to the flushing position so that flushing fluid is cycled through the head and the flushing means.

As indicated above, it is preferred to feed the flushing fluid via conduits which intersect the transverse conduits feeding the nozzle orifices. These conduits can be bores within the head block feeding inserted tubes crossing the transverse conduits, the inserted tubes having apertures for feeding the flushing fluid axially into the transverse conduits. The bores can be fed from a manifold as for the supply of the adhesive fluid to the conduits. However, it is preferred than the flushing fluid flow be fed through a single longitudinal tube which intersects each of the transverse conduits so that a single tube serves and connects all of the conduits.

The conduit or inserted tube for the flushing fluid passes transversely through and across the conduit connecting the valve chamber and the nozzle orifice. The flushing conduit or tube preferably presents a rounded upper surface to the flow of fluid through the conduit it intersects, and preferably presents a substantially semi-circular cross-section to that flow. The lower, or downstream face of the flushing fluid conduit or tube can be of the same shape, as when the tube has a substantially circular cross-section; or can have a tapered or streamlined shape, as when the tube has an inverted drop-like cross-section.

The outlet for the flushing fluid from the conduit or tube is located on the downstream wall of the tube so that the flushing fluid flowing from the tube is directed along the same line of flow as the adhesive through the conduit. Typically, the outlet is located substantially co-axially of the conduit and has a circular orifice. Thus, in a preferred form of the applicator head, the flushing fluid is fed by a tube extending longitudinally along the applicator head and generally parallel to the bore carrying the adhesive feed. The flushing fluid tube intersects with each of the transverse conduits linking the valve chambers with the nozzle orifices and extends diametrically across the conduits. The tube has a circular outlet orifice directed along the axis of the conduit.

The tube is of a suitable size for the flow of flushing fluid to be fed into the conduits. Similarly, the outlet is of a suitable size for the flow rate required. It will be appreciated that, in order to compensate for pressure drop along the tube, the diameter of the tube and the size of the outlets can be varied along the length of the tube. However, we have found that the tube can occupy a substantial proportion of the cross-sectional area of the transverse conduit, typically from 50 to 90%, notably about 75 to 90%, of the cross-sectional area of that conduit without deleteriously affecting the formation of droplets at the nozzle orifice where the fluid is fed to the nozzle orifice at pressures of from 0.05 to 1 bar. The outlet for the flushing fluid has a diameter of from 15 to 90% of the diameter of the tube and a suitable diameter can be readily determined by simple trial and error tests.

The feed of flushing fluid through the second fluid flow line is preferably controlled by a valve means for each transverse, adhesive conduit it intersects. In this way, the conduits are not in contact with any significant volume of fluid in the flushing fluid flow lines which might act in sympathy with pressure pulses within the adhesive conduit. Where a single longitudinal tube is used as the flushing fluid feed line, the transverse conduits will be interlinked with one another by this tube and it may be possible for pressure variations in one adhesive conduit (eg. as the valve serving it opens or shuts) to be transmitted from one adhesive conduit to another. It is therefore preferred to provide valve or other means for isolating the adhesive conduits from one another. Thus, it will usually be preferred to provide a valve means to the second flow line to each side of each of the adhesive conduits it intersects.

The valves used to control the flow of flushing fluid to the adhesive conduits and to isolate the adhesive conduits from one another can be selected from a wide range of types. However, a preferred form of valve is a sliding sleeve or plug type valve which can be operated pneumatically under the control of the centralised control system, eg a micro-processor, regulating the operation of the applicator head in known manner. However, it is also within the scope of the present invention for the valves to be operated by push buttons or the like protruding from one face of the print head so that the valves are automatically operated when the applicator head seats home in the flushing position.

As stated above, the applicator head moves from an operative position over the substrate (which can be a sheet of paper, plastics or the like or an article) to which the fluid adhesive is to be applied through the nozzles to its flushing position. The movement of the applicator head can be linear as when it is moved laterally from one position to the other. However, it is preferred that the movement incorporate both horizontal and vertical components so that the lower face of the applicator head carrying the nozzle orifices seats downwardly onto a seat at the flushing position to ensure sealing engagement between the applicator head and the seat. Thus, the movement of the applicator head can be achieved by mounting the head on an eccentric shaft whose rotation achieves the desired lift and traverse of the head. Other means for moving the head can be readily devised using known techniques. If desired, a number of applicator heads of the invention can be operated in conjunction with one another using a common mounting and movement mechanism.

In the flushing position, the conduits to the nozzles and the nozzles themselves are be flushed

out by passing fluid through part or all of the adhesive flow channels within the head to remove any adhesive remaining therein. This can be done merely by feeding flushing fluid to the applicator head and discharging the flushing fluid into troughs, channels or the like in the upper surface of a member at the flushing position. However, it is preferred to form the flushing position as a generally planar faced seat member with which the base of the applicator head co-operates so as to bring the nozzle orifices into register, preferably with sealing engagement, with ports in the upper face of the seat. The ports communicate with a source of flushing fluid or with bores for discharging the flushing fluid to waste or for re-cycle of the flushing fluid either directly or via a filter or other treatment. If desired, the seat member can incorporate other conduits, for example for supplying compressed air or other fluids to remove flushing fluid at the end of the flushing process, and can be connected to a pump or other means for the supply or circulation of flushing fluid.

The applicator head preferably engages with the flushing position in sealing engagement to enable recyling of the flushing fluid and back-washing to be achieved. Thus, the upper face of the member can be formed with a suitable resilient surface and/or the recesses can be provided with sealing rings or the like.

The action of seating the applicator head onto the flushing position can also be used to actuate the valves controlling the flow of flushing fluid through the applicator head, for example by depressing the protruding buttons actuating the valves in the second flow line.

The flushing fluid flows into the conduits to flush out the adhesive remaining in the conduits and the nozzles to inhibit the build up of deposits within the conduits or nozzles when operation of the print head is interrupted for any length of time. The flushing fluid can be selected from a wide range of fluids, but will preferably be an aqueous detergent composition as conventionally used in the flushing of similar equipment.

The applicator head of the invention can incorporate other features used in jet printing heads to enhance the operation thereof. Thus, the applicator head can be provided with heater means where a thermoplastic ink or adhesive is to be applied through the head; or with a buffer reservoir for storing ink or otther fluid within the head.

The applicator head of the invention finds use in the application of a wide range of fluids for a number of purposes where the fluid is to be applied intermittently and without the use of compressed air or other propulsive media. However, as indicated above, it finds especial use in applying quick drying inks or adhesives using a drop on demand technique to a wide range of products, notably to the application of adhesive to labels for application to bottles, jars or other articles or to the articles themselves to which labels are then applied. Accordingly, the present invention provides a method for securing one article, notably a label, to another by means of an adhesive characterised in that the adhesive is applied by means of a applicator head of the invention.

The compact nature of the applicator head of the invention makes it especially suitable for locations where space is at a premium and the ability to flush out the head without the need to dismantle the head is of a particular advantage. Furthermore, it will be appreciated that the flushed out applicator head can be retained in the flushing position until required to apply further quantities of the same or some other adhesive or other fluid. As a result, it is possible to pass the new adhesive through the applicator head whilst still in the flushing position at the start of the next run and to discharge that adhesive to waste through the flushing position. This enables a new run to be started with the minimum of time and with no wastage of product whilst the applicator head is being flushed out with the new adhesive to remove traces of water or detergent which may remain in the applicator head.

It will be appreciated the the flushing process can be varied to suit the particular applicator head and the adhesive or other fluid which is it desired to flush from the head. thus, the flushing fluid can be fed ar elevated temperature, using pressure pulses or with repeated changes in direction of flow so that repeated flushiongs and bck flushings takes place during a single flushing cycle.

DESCRIPTION OF THE DRAWINGS:

A preferred form of the applicator head of the invention will now be described by way of example with respect to the accompanying drawings in which:

Figure 1 is a diagrammatic transverse vertical section through the applicator head in its operative position;

Figure 2 is a transverse vertical section through the head of Figure 1 in its flushing position;

Figure 3 is a side view of a mechanism for moving the head of Figure 1; Figure 4 is a plan view of the mechanism of Figure 3;

Figure 5 is a side view of an alternative mechanism to that shown in Figure 3;

Figure 6 is a diagrammatic plan view of several of the applicator heads mounted side by side in a multi-operating head;

Figure 7 is a diagrammatic transverse vertical section through an alternative form of the head of Figure 1 in its operative position;

Figure 8 is a similar view of the head of Figure 7, but in its flushing position;

and

Figure 9 is a longitudinal section through an alternative form of the head of Figure 7.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

The applicator head of Figure 1 comprises a single head 10 carried by a support mechanism 11 or 12 from its operative position to its flushing position at which the nozzle orifices of the head engage a flushing member 13.

The head comprises a body 14 which contains a solenoid valve 16 for controlling the flow of aqueous

adhesive to a nozzle orifice 17 which is off set to one side from the outlet to the valve 16 and is connected to the valve outlet by bores 20, 21 and 22 through the body 14. Bore 20 intersects with a longitudinal bore 24 for feeding flushing fluid to the bores 20, 21, 22 and the nozzle 17. Bore 24 is connected to an external source of flushing fluid (not shown).

Bores 20 carries journalled therein a pin valve 25 which comprises a valve head 28 within bore 20 and having a shank 26, 27 which extends through a glanded seal support 31, 32, 33, 34. The free end 15 of shank 26 protrudes from the bottom face of housing 14 to act as a button by which valve head 28 can be lifted out of sealing engagement with O ring 29 at the foot of bore 20 against the bias of compression spring 30. The valve head 28 thus seals off flow of flushing fluid from bore 24 into bores 20, 21 and 22 until the free end 15 is depressed.

The solenoid valve 16 is a commercially available valve having a cylindrical casing 36 glued or otherwise secured in a bore 35 in the housing 14 with an axial valve chamber 38 extending therefrom. The valve chamber is located within the foot of bore 35 and there is an annular gap 39 between its outer face and the wall of the bore. A longitudinal bore 40 intersects the annular gap to feed adhesive from an external source (not shown) into valve chamber 38 via inlet 41 and internal bores within the valve 16 (not shown). Wound upon casing is an electromagnet coil 37 around the magnetisable valve body 44 journalled within the housing and urged downwardly by spring 78. The body 44 carries a seal surface 45 which acts upon the end of outlet pipe 42 so as to make or break the seal between the pipe and the supply of adhesive from bore 40. Pipe 42 passes through an O ring seal at the top of bore 20 so that adhesive can only flow to the nozzle orifice 17 when valve 16 is actuated to lift body 44.

Flushing position 13 comprises a generally planar plate member 49 which has a resilient upper face 56 and a longitudinal bore 50, 53 through which flushing fluid can be fed from an external source (not shown) or through which fluid can be discharged from the nozzle 17 when in the flushing position. Member 49 has a recess 54 connected by a vertical bore 51, 52 to bore 53. Recess 54 carries an 0 ring seal 55 into which the tip of nozzle 17 will bed when the head 14 is in the flushing position. The base of head 14 is stepped so that one portion of the base thereof will rest upon surface 56 when in the operative position but will be raised clear of surface 56 when the head is moved into the flushing position at which the lower step of the base (carrying the nozzle 17 and the pin valve mechanism 15, 26, 27, 28) will rest upon face 56. The upper step of head 14 carries a plug 57 which engages recess 54 to prevent ingress of dirt during the operation of the head.

The support mechanism for head 10 comprises two uprights 11 having a plate 59 slideably held between them. Head 10 is secured to plate 59. Plate 59 is mounted upon shafts 62 extending between the uprights 11 by means of two eccentrics 61. Shafts 62 are rotated by means of a rack and pinion drive 64, 65 to carry plate 59 upwards and inwards by virtue of the eccentrics 61. This has the effect of carrying head 10 from its operative position shown in Figure 1 to the flushing position shown in Figure 2.

In the variation shown in Figure 5, the plate 49 and the plate 59 are moved horizontally and vertically respectively by rams 67 and 68 so as to raise the head 10, to bring plate 49 across until nozzle 17 is in register with recess 54 and then to lower head 10 onto surface 49.

During operation of head 10, valve 16 is actuated in response to control signals from a control mechanism in the conventional manner to cause adhesive to issue from nozzle 17 as a series of droplets. During this time, the pin valve mechanism 15, 26, 27, 28 is in the closed position and adhesive flows from bore 40 through the annular gap into valve chamber 38 and through pipe 42 into bores 20, 21 and 22 to nozzle 17. When application of adhesive is interrupted, head 10 is moved into its flushing position in which nozzle 17 seats into recess 54 and valve body 44, 45 seals the end of pipe 42. Flushing fluid is fed either trough bore 24 in head 10 or bore 53 in plate 49 to cause fluid to flow trough the nozzle 17 and bores 20, 21 and 22 to remove residual adhesive therefrom. Since the flushing fluid can be fed from either of bores 24 or 53, flushing and back flushing can be carried out with alternation between them if desired.

It will be appreciated that the pin valve assembly can be replaced by a conventional valve operating on the input to either of bores 24 or 53 and under the control of the control mechanism regulating the operation of the applicator head.

In the form of head shown in Figure 6, a number of valves 16 are mounted with one head 10. The valves are mounted in staggered rows with their underlying pin valve assemblies 27, 33 as shown, with their nozzle outlets 17, 69 lying along a common axis so as to achieve a compact construction.

In the alternative form of applicator head shown in Figures 7, 8 and 9, the applicator head comprises a generally rectangular block 101 of metal, eg. aluminium or stainless steel, having a longitudinal bore 102 serving as the distribution manifold for the flow of an aqueous PVA based adhesive composition fed at a pressure of about 0.8 bar from an air pressurised reservoir (not shown). The bore 102 intersects a number (in this case only two are shown) of generally vertical transverse bores 103. Into each of the bores 103 is located an electromagnetic valve 104 secured into the bore by any suitable means (not shown) and sealed in place by O rings or other sealing means 105.

The valve 104 has an inlet 106 communicating with the foot of the bore 103 whereby the valve is fed with fluid from bore 102. The valve 104 has an outlet 107 which is a sealing fit into a narrower continuation of bore 103 and which acts as the conduit 108 for feeding fluid from the valve to a nozzle outlet at the foot of the conduit 108. The nozzle outlet typically comprises a jewel orifice 109 with a nozzle orifice diameter of from 300 to 500 micrometres. If desired, the nozzles can be held in a nozzle plate assembly mounted on the print head block 101.

The operation of the valve is controlled in the normal manner for a drop on demand printer by a

suitable control system (not shown) to deposit the desired array of adhesive drops at the desired location onto an article passing the print head, eg. a label from a web of pre-printed labels drawn off a roll and cut to the desired size by a suitable cutter.

The print head is provided with a second londitudinal bore which serves as the fliud flow line for the flushing fluid. This bore can be offset from the conduits 108 as shown in Figure 7; or can be aligned with and intersect the conduits 108 as shown in Figure 9. With the design shown in Figure 7, the bore connects with a tube 111 which intersects the conduit. In the case of the design shown in Figure 9, the bore houses an insert tube 111 which is carries the flushing fluid to the conduits.

The bore and hence the tube 111 is connected to a source of flushing fluid (not shown). The tube 111 has an aperture 112 in its lower face in register with each of the conduits 108 as shown. The flow of fluid through the tube 111 is controlled by a series of push valves 113. In the case of the design of Figure 9, it is necessary to provide a valve to each side of each conduit as shown in Figure 9 so that during normal operation of the print head, the conduits are isolated from one another and from the supply of flushing fluid. Each of the valves 113 has an actuating stem 114 extending through a bore in the print head 101 to provide a protruding push button at the base of the print head. Normally, the valves 113 are urged into their closed position by for example spring 115. However, when the stem 114 is depressed, as shown in Figure 8 and with the right hand valve of Figure 9, the valve moves out of register with the bore of tube 111 to allow flushing fluid to flow into the conduits 108 and out through the nozzles 109.

In normal operation, the valve head is located as shown in Figure 7 with all the stems 114 fully extended to prevent flushing fluid from entering conduit 108 and to isolate each of the conduits from one another. When operation is interrupted and it is desired to flush out the conduits 108 and the nozzle orifices 109, the head 101 is retracted so that its bottom face bears against a platform 120. The platform 120 has a series of recesses 121 adapted to receive the nozzles 109 and a series of bores connecting the recesses 121 with a flushing fluid discharge line 122. The stems 114 bear against the top face of platform 120 and are depressed as the print head seats home onto the platform to allow flushing fluid to flow through the conduits 108 and the nozzles 109. If desired, the front face of the platform 120 may be chamfered, tapered or otherwise formed so that the stems 114 can be progressively depressed as the print head 101 moves laterally onto the platform. Movement of the print head from its operative position clear of the platform to its inoperative position seated upon the platform can be achieved by any suitable mechanism.

In place of actuation of the valve stems 114 by seating the print head onto platform 120, the valves can be actuated by any other suitable mechanism where the print head remains stationary.

In a particular example of the use of the print head of Figure 7, an aqueous PVA adhesive is fed at a pressure of 0.8 bar through quick acting solenoid valves to jewel nozzle outlets with an orifice diameter of 400 micrometres to apply the adhesive to pre-printed labels which are then applied by pressure pad or air blast to bottles. The conduits feeding adhesive from the valves to the nozzles are 1.4 mms in diameter and the flushing fluid tube is 1.0 mms diameter mounter diametrically across the conduits with an outlet 0.3 mms in diameter directed axially along the conduits.

Again it will be appreciated that the device shown in Figures 7 to 9 may be modified so that the pin valves 13, 14, 15 are replaced by valves operated electrically, pneumatically or otherwise from the control mechanism regulating operation of the applicator head.

Claims

1. A fluid applicator head 10, 101 in which fluid is to be ejected as a series of droplets through a nozzle orifice 17, 109, which applicator head can be flushed out by passing a flushing fluid through the nozzle orifice 17, 109, characterised in that the applicator head 10, 101 is adapted to be moved between a first, operative position at which it can apply droplets of a fluid to a substrate opposed to the nozzle orifice 17, 109, and a second, flushing position at which the nozzle orifice co-operates with a flushing member 13, 120 incorporating fluid flow conduits 51, 52, 53, 121, 122, whereby flushing fluid can be caused to flow through the nozzle orifice 17, 109.

2. An applicator as claimed in claim 1 wherein the flow of fluid to the nozzle orifice 17, 109 is controlled by an electromagnetic valve 16, 104.

3. An applicator as claimed in either of claims 1 or 2 wherein the flushing position comprises a member 13, 56, 120, against which area of the applicator head 10, 101 adjacent the nozzle orifice 17, 109 is adapted to seat and through which flushing fluid can be caused to flow in either or both directions through the nozzle orifice 17, 109.

4. An applicator as claimed in any of the preceding claims wherein the applicator head 10, 101 is reciprocated and/or pivotted to move into register with a flushing member 49, 120 having a surface adapted 56 to receive the nozzle orifice face of the applicator head 10, 109 in a sealing engagement and having conduits 51, 52, 53, 54, 121, 122 therein to receive flushing fluid from the nozzle orifice 17, 109 and/or from a source of flushing fluid 50, 122.

5. An applicator as claimed in any one of the preceding claims having a first fluid conduit 108 whereby fluid can be caused to flow through a nozzle orifice 109 located terminally upon the fluid flow conduit 108 and having a second fluid duct 111 which intersects the first conduit 108 and is provided with an aperture 112 through which fluid from the second fluid duct 111 can

flow into the first conduit 108, said aperture 112 being located within the first conduit 108 and being directed substantially along the intended line of flow of fluid through said first conduit 108.

6. An applicator as claimed in claim 5 wherein the second fluid duct 111 is provided as a substantially cylindrical tube 111 which passes diametrically through the first conduit 108 and the aperture 112 for the second fluid is located substantially upon the longitudinal axis of the said first conduit 108.

7. An applicator as claimed in claim 5 wherein the second duct 111 has a plan area normal to the line of flow of fluid through the first conduit 108 which is from 40 to 95% of the cross-sectional area of the first conduit 108 at that point.

8. An applicator as claimed in any one of the preceding claims 1 to 4 wherein the flushing fluid is to be fed to a conduit 21, 22, 23 which is used to feed fluid directly from the valve mechanism 16 to the nozzle outlet 17.

9. An applicator as claimed in any one of the preceding claims wherein the flow of flushing fluid is prevented by a valve mechanism 15, 27, 28, 113, 114 which is actuated when the applicator head 10, 101 is in the flushing position.

10. An applicator as claimed in any one of the preceding chambers 35, 103 each having means for receiving a valve mechanism 16, 104 in sealing engagement therewith and serving a nozzle outlet 17, 109; which valve mechanism 16, 104 is provided with a fluid inlet 40, 41, 106 and a fluid outlet 42, 107 thereto; the block 14, 101 having a longitudinal fluid feed bore 40, 102 for feeding fluid from an external source to the inlet 41, 106 of each of the valve mechanisms 16, 104; the outlet 42, 107 from the valve mechanism 16, 104 being in fluid flow communication with a transverse conduit 20, 21, 22, 108 serving the nozzle orifice 17, 109.

11. An applicator as claimed in claim 10 wherein the block 101 is provided with a second longitudinal bore 111 which intersects each of the transverse conduits 108 between the valve outlets 107 and the nozzle orifices 109; said second longitudinal bore 111 has an outlet 112 for feeding flushing fluid from the second bore 111 axially into the transverse conduit 108; said second longitudinal bore 111 having valve means 114, 115 for controlling the flow of flushing fluid to the transverse conduits 108.

12. An applicator as claimed in claim 1 wherein the lower face of the applicator head 10, 101 carries the nozzle orifice 17, 109 and the head 10, 101 is moved between its operative and flushing positions by means 61, 62, 64, 65 which cause both horizontal and vertical components of movement whereby the lower face of the applicator head 10, 101 carrying the nozzle orifice 17, 109 seats downwardly onto a seat 49, 56, 120 at the flushing position to ensure sealing engagement between the applicator head 10, 101 and the seat 49, 56, 120.

13. An applicator as claimed in claim 12 wherein the flushing position is provided as a generally planar seat member 49, 56, 120 having a port 54, 121 in the upper surface thereof in association with fluid transport conduits for the supply or removal of flushing fluid and with which the base of the applicator head co-operates so as to bring the nozzle orifice into register with the said port.

14. An applicator head as claimed in claim 1 substantially as hereinbefore described with respect to and as shown in the accompanying drawings.

15. A method for discontinuously applying a first fluid to a substrate which method comprises causing droplets of the first fluid to be ejected from the nozzle orifice 17, 109 of an applicator head 10, 101 as claimed in claim 1 when in its operative position; moving the applicator head 10, 101 from its first position to its second position when it is desired to interrupt the application of the first fluid to the substrate and to flush out the applicator head 10, 101; and causing a flushing fluid to flow through the said orifices 17, 109 to remove said first fluid from at least part of the flow path of said first fluid through said applicator head 10, 101.

16. A method as claimed in claim 15 wherein the first fluid is an aqueous adhesive composition.

17. A method as claimed in claim 15 wherein the flushing fluid is aqueous.

18. A method as claimed in claim 15 wherein residual flushing fluid is subsequently removed from the applicator.

19. The use of an applicator head as claimed in any one of claims 1 to 14 in the application of an aqueous adhesive composition to a substrate.

Fig.1.

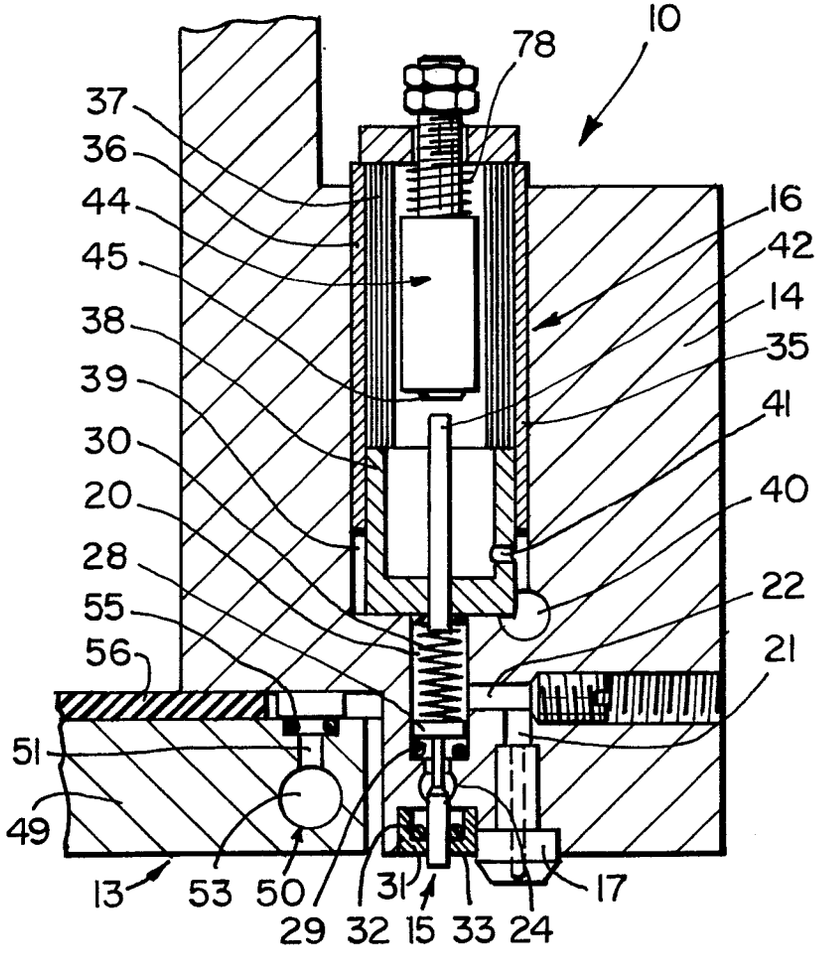
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Fig.2.

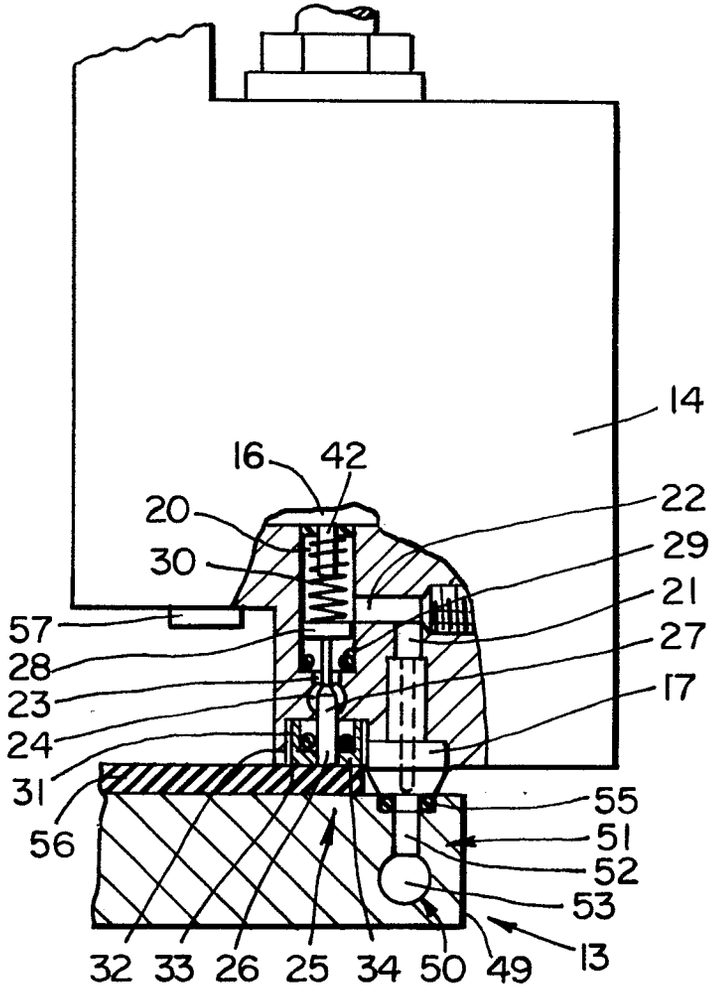
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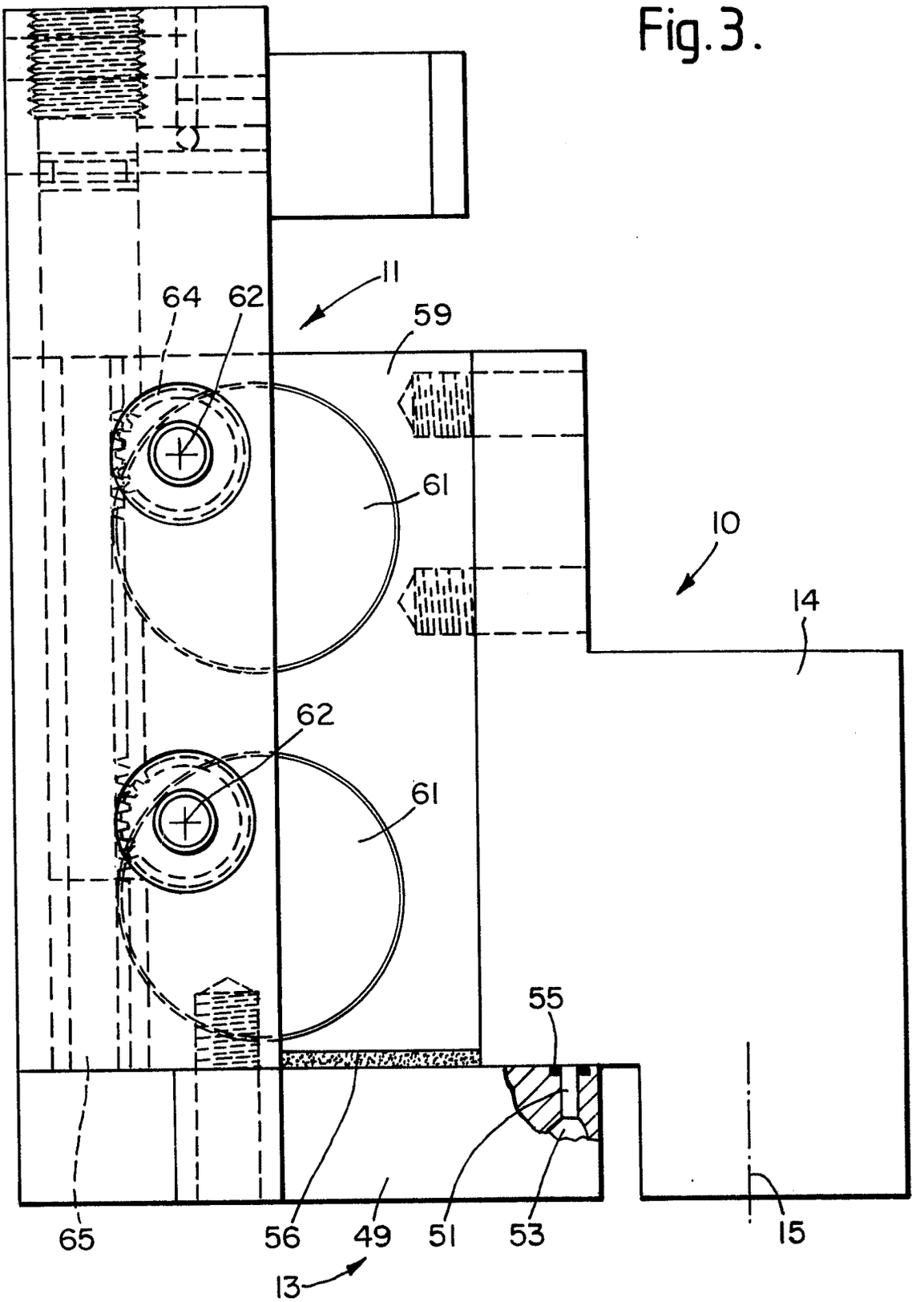
Fig.3.



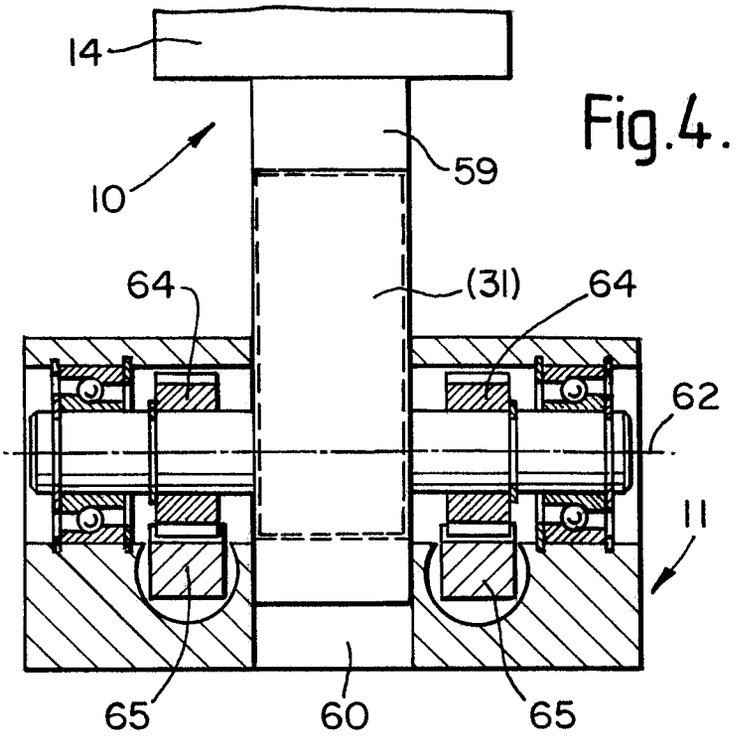


Fig.4.

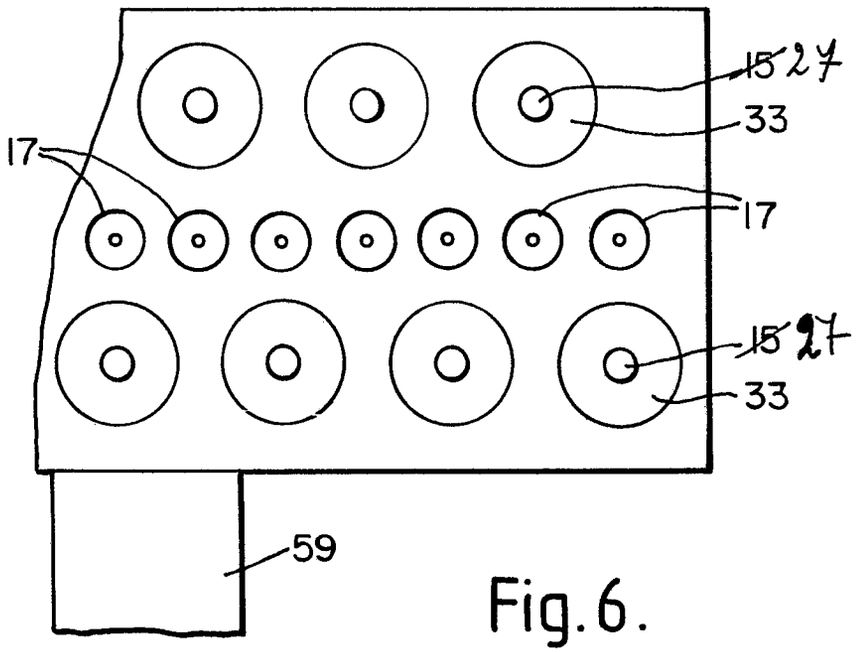


Fig.6.

Fig.5.

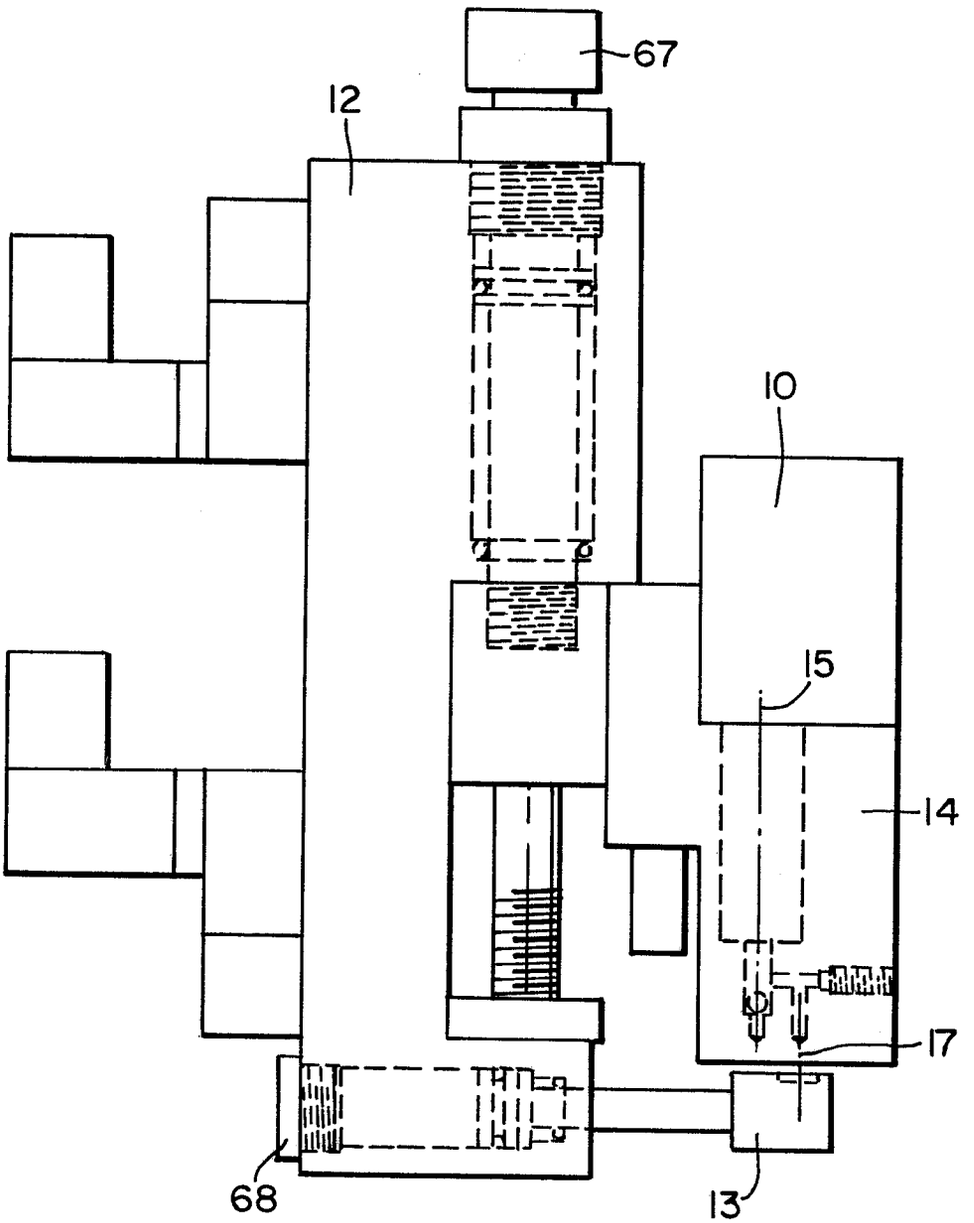


Fig.7.

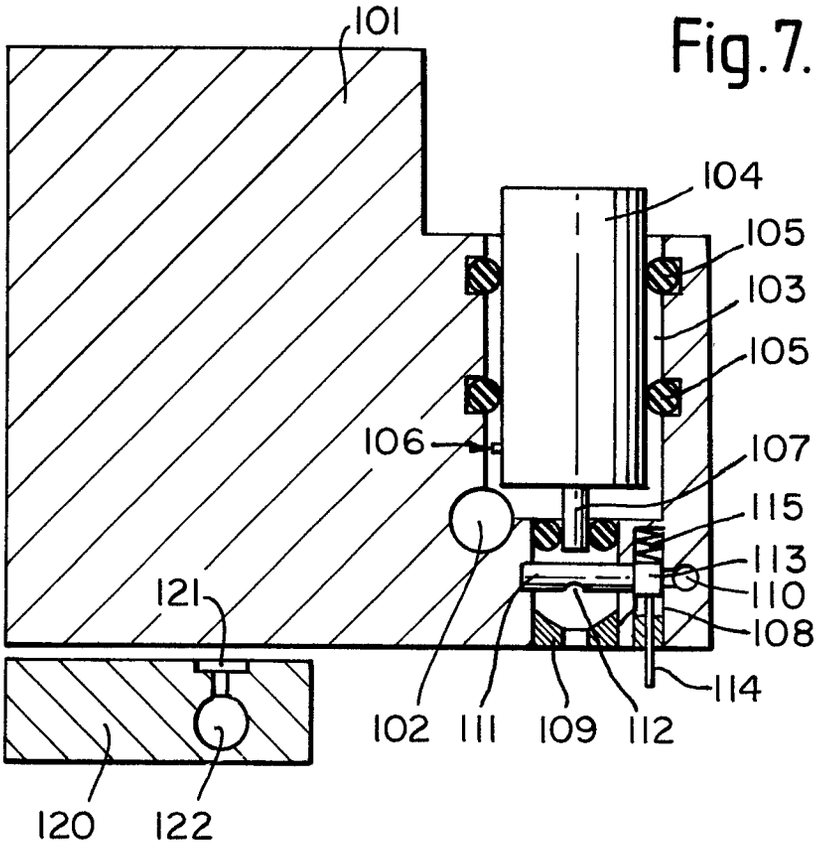

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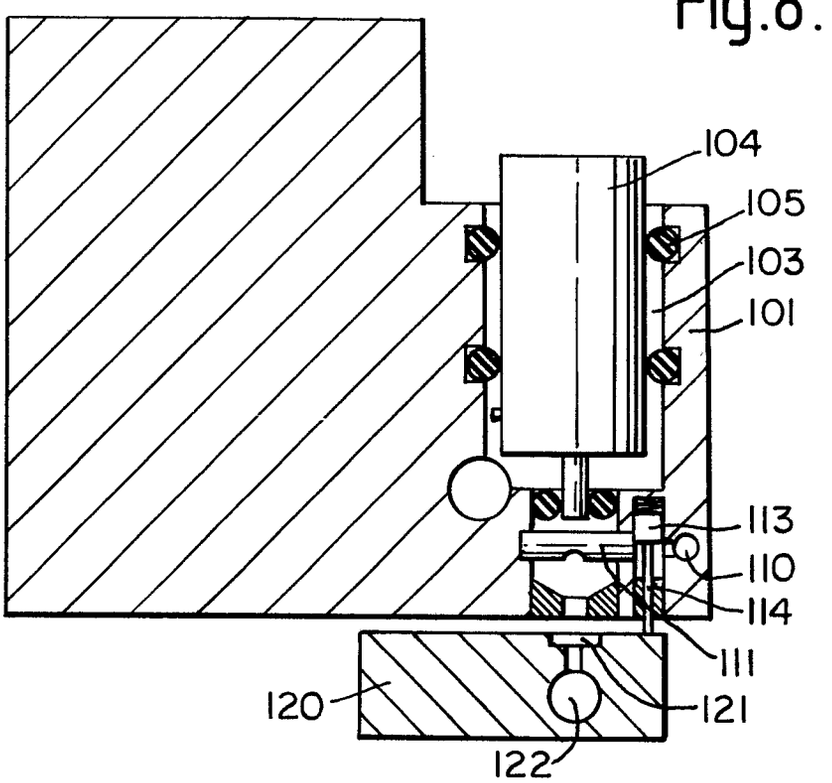
Fig.8.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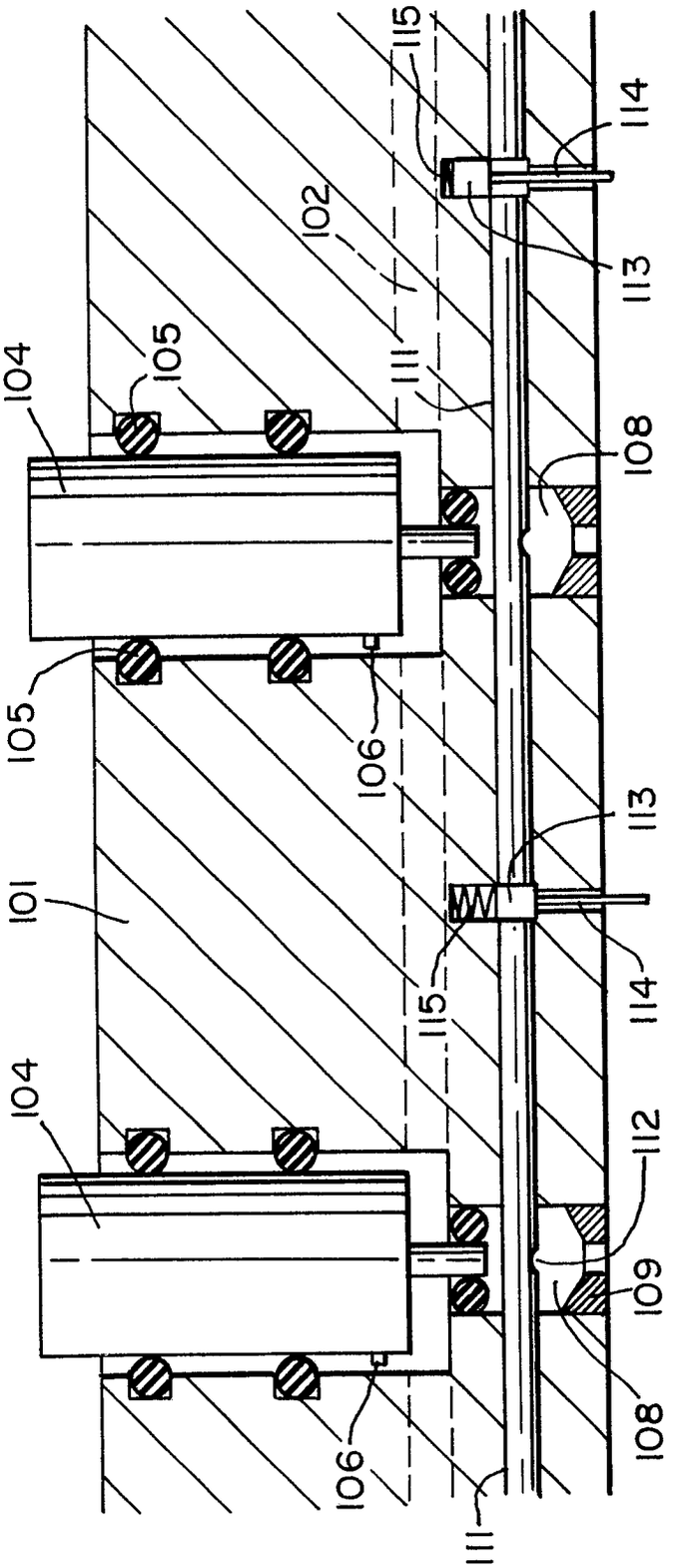
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Fig.9.

European Patent Office

EUROPEAN SEARCH REPORT

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 87308876.9

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl 4)
X	DE - A1 - 3 604 373 (SHARP K.K.) * Fig. 1,2; pages 1-12 *	1,15	B 41 J 3/04 B 05 B 15/02
A		2-4,8-10,12,13,17,18	
A	DE - A1 - 3 020 109 (RICOH) * Fig. 1; pages 1-11 *	1-4,8,9,15,17	
A	DE - A1 - 3 203 014 (SANYO DENKI) * Fig. 1-6; pages 12-19 *	1,15	
A	GB - A - 2 094 180 (SEALED AIR CORP.)		

TECHNICAL FIELDS SEARCHED (Int. Cl 4)

B 41 J
B 05 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	14-12-1987	WITTMANN

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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