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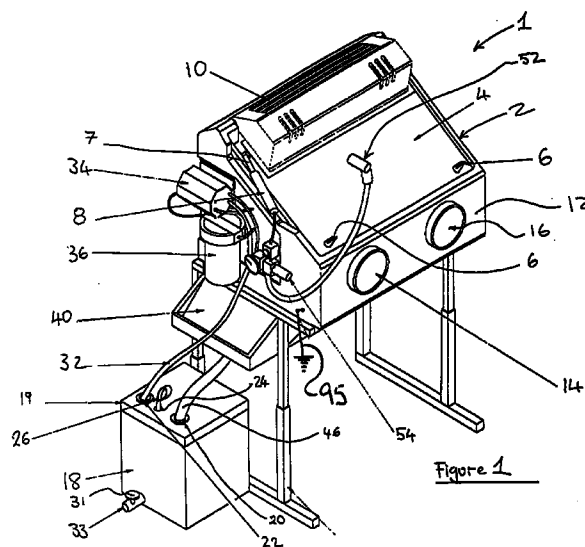
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(54) Cleaning apparatus

(57) With reference to Figure 1, solvent cleaning apparatus 1 comprises a sealable enclosure 2 containing a solvent fluid discharge nozzle (Figure 7) in the form of a trigger-operable discharge nozzle 130. The enclosure 2 is of electrically conductive plastics material and is provided with an earth 95 whereby a substantial build-up of static electricity does not take place. The enclosure 2 is provided with a substantially flat rectangular access door 4 of toughened glass pivotally mounted about a horizontal axis, provided with a pneumatic lock assembly comprising a piston 7 and cylinder 8. Located at the uppermost region of the door 4 is a light unit 10 providing, in use, additional illumination for the inside of the enclosure 2. The front panel 12 of the enclosure 2 is formed with two circular access glove ports 14, 16, used to operate the trigger of the discharge nozzle and to manipulate the article being cleaned. The solvent cleaning fluid is stored in a reservoir box 18 formed with an inlet port 20 and an outlet port 22. In use, the solvent fluid is drawn from the reservoir box 18, via a pick-up tube 32 by way of a diaphragm pump 34, to be transported to the enclosure 2 via a cartridge filter 36. Once the solvent liquid has been discharged through the discharge nozzle within the enclosure 2, it falls under gravity into a collection tray 40 to return to the reservoir box 18.



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Description

BACKGROUND TO THE INVENTION

The present invention relates to solvent cleaning apparatus and cleaning systems.

SUMMARIES OF THE INVENTION

According to a first aspect of the present invention, there is provided solvent cleaning apparatus for cleaning articles comprising an enclosure, at least a substantial portion of the walls of the enclosure being formed of an electrically-conductive plastics material, with earth grounding means, cleaning fluid transportation means, and cleaning fluid discharge means located within the enclosure, the arrangement being such that, in use, the discharge means provides a discharge of cleaning fluid supplied by the fluid transportation means, and the earth grounding means serving to conduct any static electricity present away from the enclosure.

The cabinet is preferably formed of a plastics material which is resistant to petroleum-based solvent cleaning fluids. The plastics material is preferably resistant to petroleum distillate solvent cleaning fluids.

The cabinet may be manufactured by rotational moulding techniques.

Preferably, the enclosure comprises an access panel sealable to prevent fluid escaping from the enclosure and providing access to the inside of the enclosure. The access panel may be of substantially transparent plastics material but preferably it is of substantially transparent glass. The apparatus also preferably comprises fluid reservoir means.

Preferably the fluid discharge means comprises a nozzle. The nozzle may incorporate an end brush and is preferably operated by a trigger means. A plurality of such nozzles may be provided. The nozzles preferably do not substantially atomise the cleaning fluid.

The fluid transportation means preferably comprises pump means to convey, in use, fluid to the nozzles via filter means and out through the nozzles. The pump means is preferably a pneumatic diaphragm pump. The filter means is preferably a pressure filter element.

The enclosure also preferably comprises locking means, the arrangement being such that in use, access to the enclosure is prevented for a predetermined time period after the fluid discharge means has ceased to operate.

The locking means preferably comprises a pneumatic lock.

The apparatus preferably comprises fluid collection means arranged in use to be located substantially below the fluid discharge means, whereby in use the collection means collects and transports the fluid away from the enclosure following the main cleaning process and into the fluid reservoir means.

Preferably the surfaces exposed to cleaning fluid or cleaning fluid vapour of the pump means, transportation means, fluid discharge means and enclosure are electrically conductive such that, in use, there is not a substantial build-up of static electricity. The exposed surfaces of the collection means are also preferably electrically conductive.

The dimensions of the apparatus are such that the apparatus can be transported through a standard doorway without any prior dismantling of the apparatus.

According to a second aspect of the present invention there is provided solvent cleaning apparatus for cleaning articles comprising an enclosure provided with discharge means disposed therein, pneumatic locking means and pneumatic time delay means such that, in use, the pneumatic time delay means and pneumatic lock means prevent the opening of the enclosure for a predetermined time after the discharge means has ceased to discharge solvent cleaning fluid.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

A solvent cleaning apparatus and a modification thereof, each in accordance with the present invention, will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows an isometric view of the solvent cleaning apparatus,

Figure 2 shows a rear elevation of the apparatus,

Figure 3 shows a side elevation of the apparatus,

Figure 4 shows a front elevation of the apparatus,

Figure 5 shows the opposite side elevation to that shown by Figure 3, and

Figure 6 is a pneumatic block circuit diagram showing the pneumatic components of the apparatus,

Figure 7 is a view similar to Figure 3, partly cut away, of a modified apparatus and showing the internal fluid discharge nozzle, and

Figure 8 is a modified block circuit diagram in accordance with the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to Figures 1 to 5, and 7, a solvent cleaning apparatus 1 comprises a sealable enclosure 2 of electrically conductive plastics material containing fluid discharge means (Figure 7) in the form of a trigger operable discharge nozzle 130 disposed at one end of a

flexible discharge tube 131¹. The apparatus 1 is provided with earth grounding means 95, (Figure 1) which serve to conduct any static electricity which may be present, away from the enclosure 2.

The discharge nozzle incorporates an end brush 131. Several such nozzles 130 may be provided. The end brush 131 comprises a ring of bristles, some of which are made of polyamide for strength and resilience, and others are of conductive brass. The brass bristles are earthed by way of the hose 131¹, which is of conductive material and is electrically connected by way of valving to the supporting framework 132.

A suitable filter 133 is provided in the liquid supply to nozzle 130.

The enclosure 2 is provided with a substantially flat rectangular access door 4 pivotally mounted about axis XX (see Figure 4). The door 4 is made from substantially transparent toughened glass, (or plastics material), and is provided with two lockable mechanisms 6 disposed at the periphery of the lowermost region, and a pneumatic lock assembly comprising a piston 7 and cylinder 8. The piston 7 is coaxially disposed within the cylinder 8 and being in slidable contact therewith. Located at the uppermost region of the door 4 is a light unit 10 providing, in use, additional illumination for the inside of the enclosure 2.

Tecrathene is an example of a plastics material which has suitable electrically conductive properties. It will be appreciated that any equivalent material having suitable electrically conductive properties may be used for at least a substantial part of the walls of the enclosure 2.

The front panel 12 of the enclosure 2 is formed with two access glove ports 14, 16, of suitable shape. For example, of circular or oval outline. Extending inwardly from the respective ports 14, 16 are gloves (not shown) which are used to operate the trigger of the discharge nozzle and manipulate the article being cleaned without the need to open the access door 4. The interfaces between the gloves and the ports 14, 16 provide a fluid tight seal between the inside of the enclosure 2 and the outer atmosphere.

The solvent cleaning fluid is stored in a reservoir box 18 comprising a removable rectangular closure 19 formed with a circular inlet port 20, a circular outlet port 22 and a port 24 formed to receive a dipstick 26. Extending upwardly from the ports 20, 22 are flame arresters 28, 30. (See Figures 2 to 5). The reservoir box 18 is preferably of steel.

With particular references to Figures 2 to 5, in use, the solvent fluid is drawn from the reservoir box 18, via a pick-up tube 32 extending from the arrester 28, by a diaphragm pump 34. The pump 34 then transports the solvent to the enclosure 2 via (in this example) a twenty five micron pressure element cartridge filter 36, externally disposed. However, if desired the filter 36 can be disposed within the enclosure 2.

Once the solvent liquid has been discharged

through the discharge nozzle within the enclosure, it falls under gravity into the collection tray 40 and flows down the sloping basal walls of the tray 40 towards an outlet port 42 (Figure 2) disposed at the lowermost point of the tray 40. Extending downwardly from the port 42 is a removable filter 44 (Figure 3). The collected solvent flows through the filter 44 and back into the reservoir 18 via a connection tube 46 extending between the flame arrester 30 and the filter 44. The solvent within the reservoir 18 can then be re-used by being drawn through the tube 32. Alternatively, the solvent can be drained from the reservoir via a drain valve 31 and drain nozzle 33.

The enclosure 2 is provided with vent means comprising an extraction and solvent vapour condenser 50 disposed at the rear of the enclosure 2. The vent means prevents occupational vapour levels escaping from the enclosure 2 to the outer atmosphere. Actual levels depend on the solvent used but solvent vapour of 300 parts per million or greater is a typical value.

The enclosure 2 is also provided with a pneumatic spray nozzle and trigger assembly 52. This assembly 52 is used to blow off excess solvent residue left on the article after the solvent cleaning process. The pneumatic spray nozzle assembly 52 is supplied with external compressed air via an inlet port 54.

Contained within the enclosure 2 is a plurality of support grids, 134 in Figures 7, which are used for supporting the articles being cleaned by the liquid solvent. The grids are of electrically conductive material, or at least the surface of the grids is electrically conductive, and the grids are suitably electrically attached to the enclosure 2 and thence to the earth 95, such that static electricity does not build up on the grids.

In the arrangement of Figure 7, a downwardly projecting portion 135 of the grid 134 provides a coarse filter in the tray 40.

When the pneumatic pump 34 is turned on, it continues to run until a pressure of between 3 to 8 bar has been built within the system downstream (outlet side) of the pump. The pressure is released when the operator depresses the trigger of the discharge nozzle within the enclosure. Cleaning solvent liquid flows from the discharge nozzle and its end brush on to the component requiring cleaning. As solvent liquid flows out of the discharge nozzle the pressure downstream of the pump will begin to fall. At a predetermined pressure value the pump will automatically start again to maintain a pressure downstream of approximately 5 bar.

When the operator releases the trigger of the discharge nozzle a pneumatic time delay means is activated. The time delay means prevents the door 4 from being opened for a pre-set time of approximately 30 seconds. This allows the solvent to drain from the enclosure 2 into the reservoir box 18. After the pre-set time the lock assembly comprising the piston 7 and cylinder 8 is activated and the door is opened.

The pneumatic components of the apparatus are

supplied with compressed air via the inlet port 54.

Figure 6 is a schematic illustration of pneumatic components of the solvent cleaning apparatus and shows how those components are interconnected.

Figure 6 shows a pressurised air supply pipe 100, connected to the air inlet port 54 of Figure 1, an isolation valve 101, an air filter 102, and an air pressure gauge 103. Pressurised air, at between 4.5 bar and 7.0 bar, is supplied by the pipe 100 to pneumatic control valves 104 to 110.

The pneumatic valve 108 controls air flow to the actuating chamber 115 of the diaphragm pump 34, (Figure 1), which is groundable. The pump 34 also has a pumping chamber 116 to which pick-up tube 32 and filter element 36 are connected.

The pneumatic valve 109 discharges the solvent vapour enclosure vent means 50. The valve 110, which serves as a pressure relief valve, discharges air to the pneumatic spray nozzle assembly by way of line 117.

Pneumatic valve 107 forms part of a delay timer 118, which also incorporates a spring-loaded pressure relief valve 119. Valve 107 is connected, by a line 120, to the valve 106, which controls the piston 7 and cylinder 8 access door lock assembly of Figure 1.

Pneumatic valve 104 is operable by opening and closing the access door 4, which when closed, causes valve 105 to permit the solvent cleaning process to take place, by operating the various components, including pump control valve 108. When rendered inoperative, by opening of access door 4, the process control valve 105 exhausts air to atmosphere by way of a silencer 125.

The modified circuit diagram of Figure 8 relates to the modified assembly of Figure 7 in which many valve units have been positioned within the enclosure 2 for safety reasons. Filter 133 is a similar unit to filter unit 36 but is located internally of enclosure 2.

Claims

1. Solvent cleaning apparatus for cleaning articles comprising an enclosure (2), at least a substantial portion of the walls of the enclosure being formed of an electrically-conductive plastics material, with earth grounding means (95), cleaning fluid transportation means (34, 36; 133, 131¹), and cleaning fluid discharge means (130) located within the enclosure, the arrangement being such that, in use, the discharge means provides a discharge of cleaning fluid supplied by the fluid transportation means, and the earth grounding means serves to conduct any static electricity present away from the enclosure.
2. Apparatus as claimed in claim 1, wherein the cabinet is formed of a plastics material resistant to petroleum-based solvent cleaning fluids.
3. Apparatus as claimed in claim 2, wherein the plastics material is resistant to petroleum distillate solvent cleaning fluids.
4. Apparatus as claimed in claim 1, 2 or 3, wherein the enclosure is provided with an access door (4) sealable to the enclosure so as to prevent fluid escaping from the enclosure, the door also providing access to the inside of the enclosure.
5. Apparatus as claimed in claim 4, wherein the access door is of substantially transparent glass.
6. Apparatus as claimed in claim 4, wherein the access door is of substantially transparent plastics material.
7. Apparatus as claimed in any one of claims 1 to 6, provided with cleaning fluid reservoir means (18).
8. Apparatus as claimed in any one of claims 1 to 7, wherein the cleaning fluid discharge means comprise at least one nozzle (130), operable by trigger means.
9. Apparatus as claimed in claim 8, wherein the said nozzle incorporates an end brush (131).
10. Apparatus as claimed in claim 8, wherein the nozzle(s) do not atomise the cleaning fluid.
11. Apparatus as claimed in any one of claims 1 to 10, wherein the fluid transportation means comprise pump means (34) to convey, in use, fluid to the fluid discharge means via filter means (36; 133).
12. Apparatus as claimed in claim 10, wherein the pump means comprise diaphragm pump means.
13. Apparatus as claimed in claim 11 or 12, wherein the filter means comprise a pressure filter element.
14. Apparatus as claimed in any one of claims 1 to 13, wherein the enclosure is provided with delay means (107, 119) whereby access to the enclosure is prevented for a predetermined time period after the fluid discharge means has ceased to operate.
15. Apparatus as claimed in claim 14, wherein the delay means comprise a pneumatic lock (107, 119).
16. Apparatus as claimed in any one of claims 7 to 15, provided with fluid collection means (40) located substantially below the fluid discharge means, whereby in use the collection means collects and transports cleaning fluid away from the enclosure and into the cleaning fluid reservoir following the article cleaning process.

17. Apparatus as claimed in any one of claims 1 to 16, provided with a pneumatic spray nozzle (52), operable so as to blow-off excess solvent residue left on the article after the cleaning process.

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18. Apparatus as claimed in any one of claims 1 to 17, provided with article support grids (134) disposed within the enclosure, said support grids being electrically conductive.

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19. Solvent cleaning apparatus for cleaning articles, comprising an enclosure (2) provided with solvent cleaning fluid discharge means (130) disposed therein, pneumatic locking means (6, 7, 8) and pneumatic time delay means (107, 119) such that, in use, the pneumatic time delay means and pneumatic lock means prevent the opening of the enclosure for a predetermined time after the discharge means has ceased to discharge solvent cleaning fluid.

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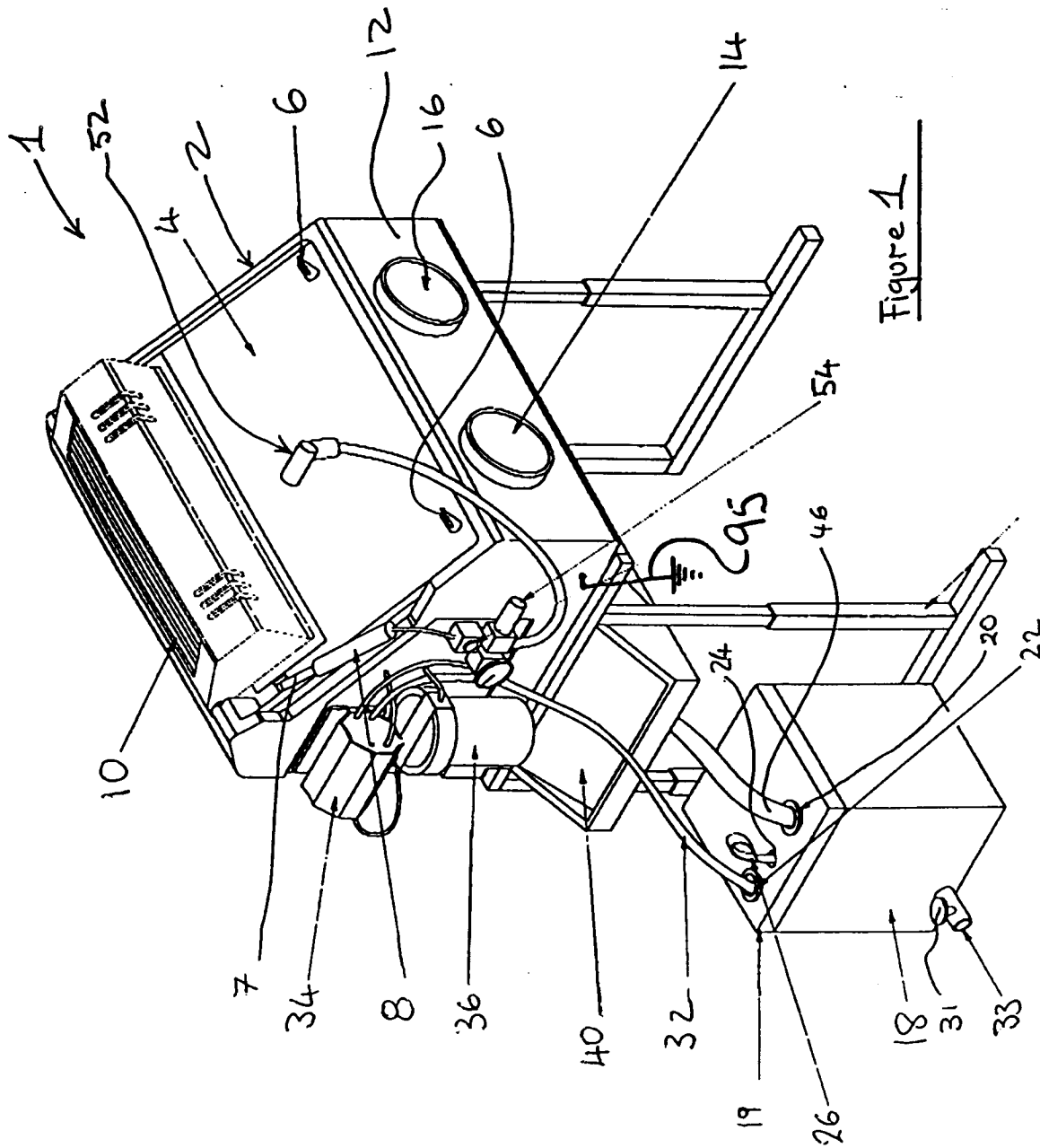
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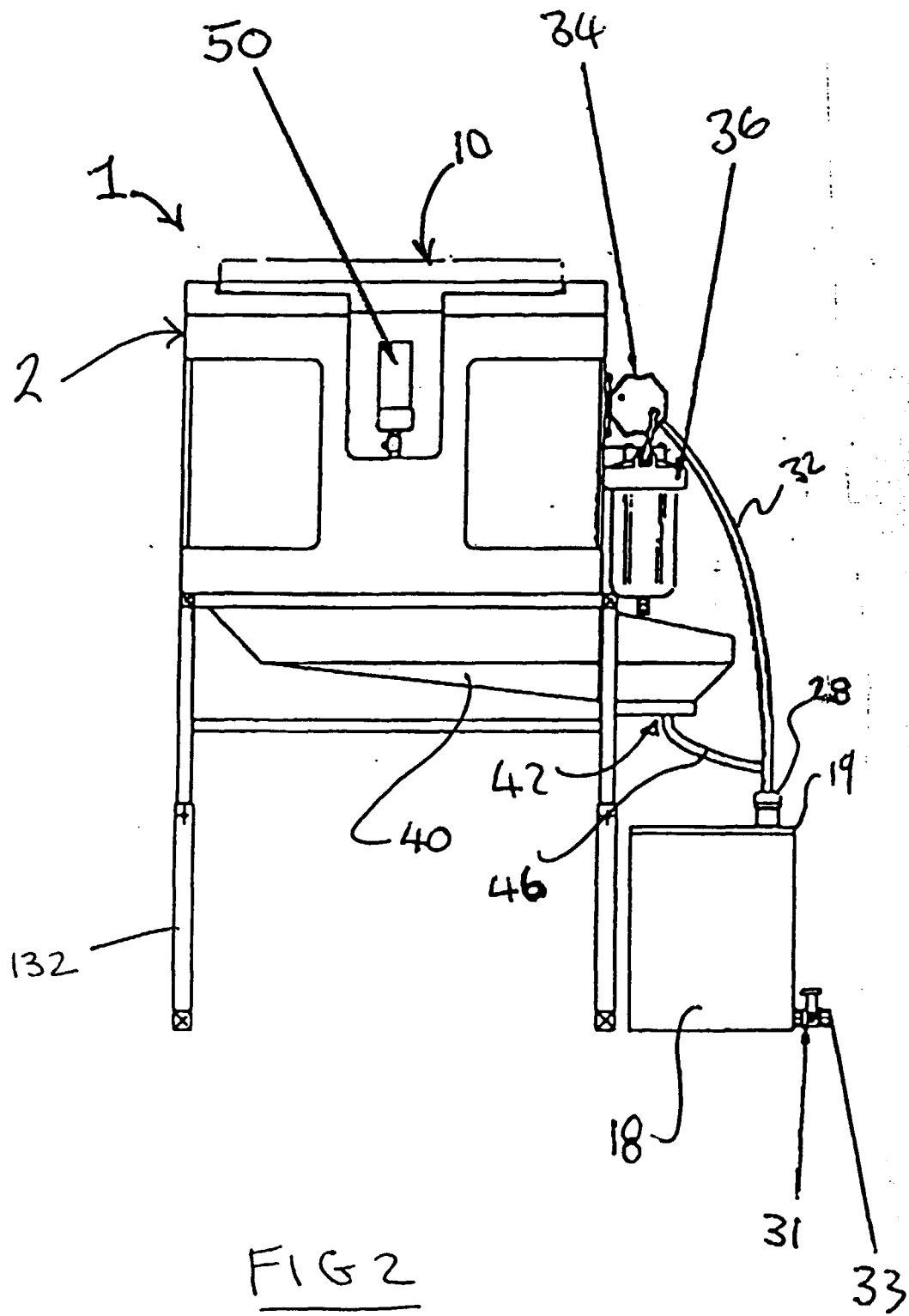
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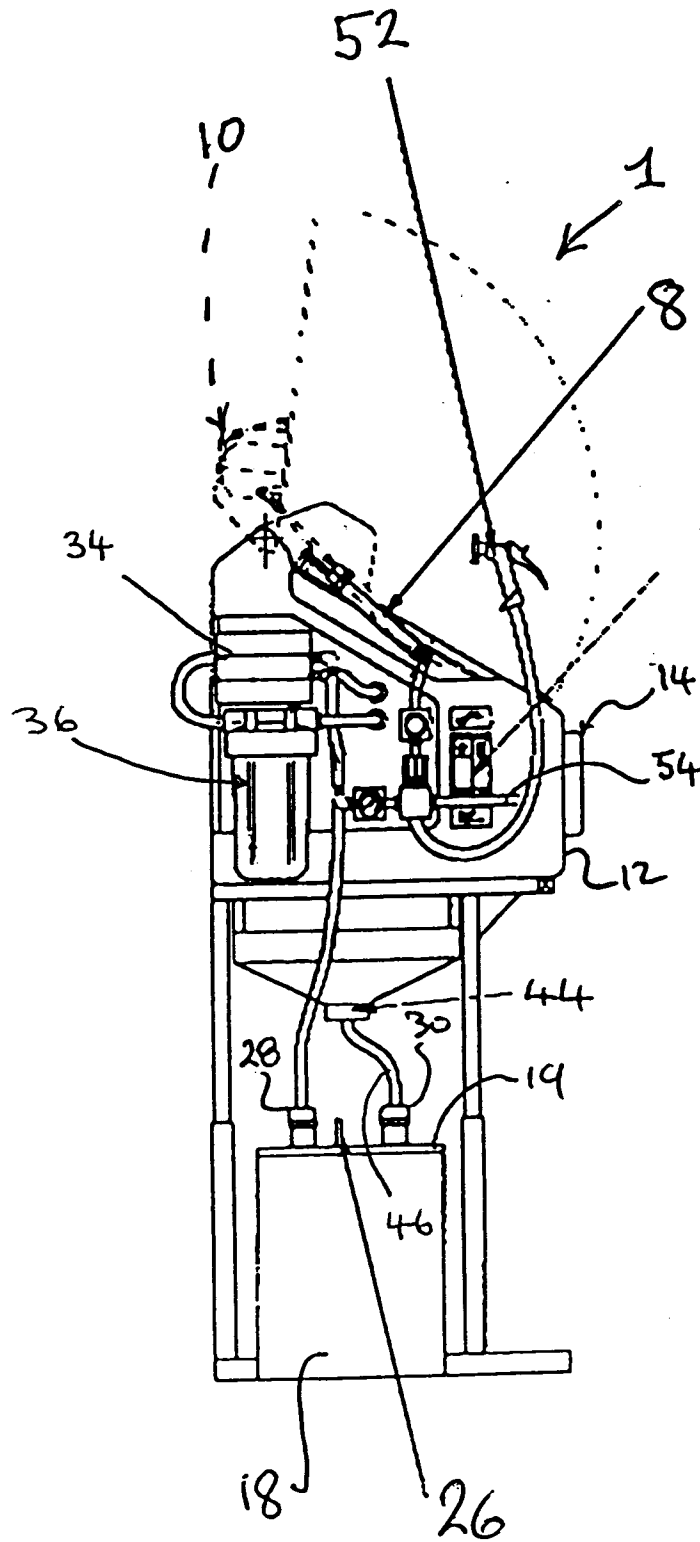
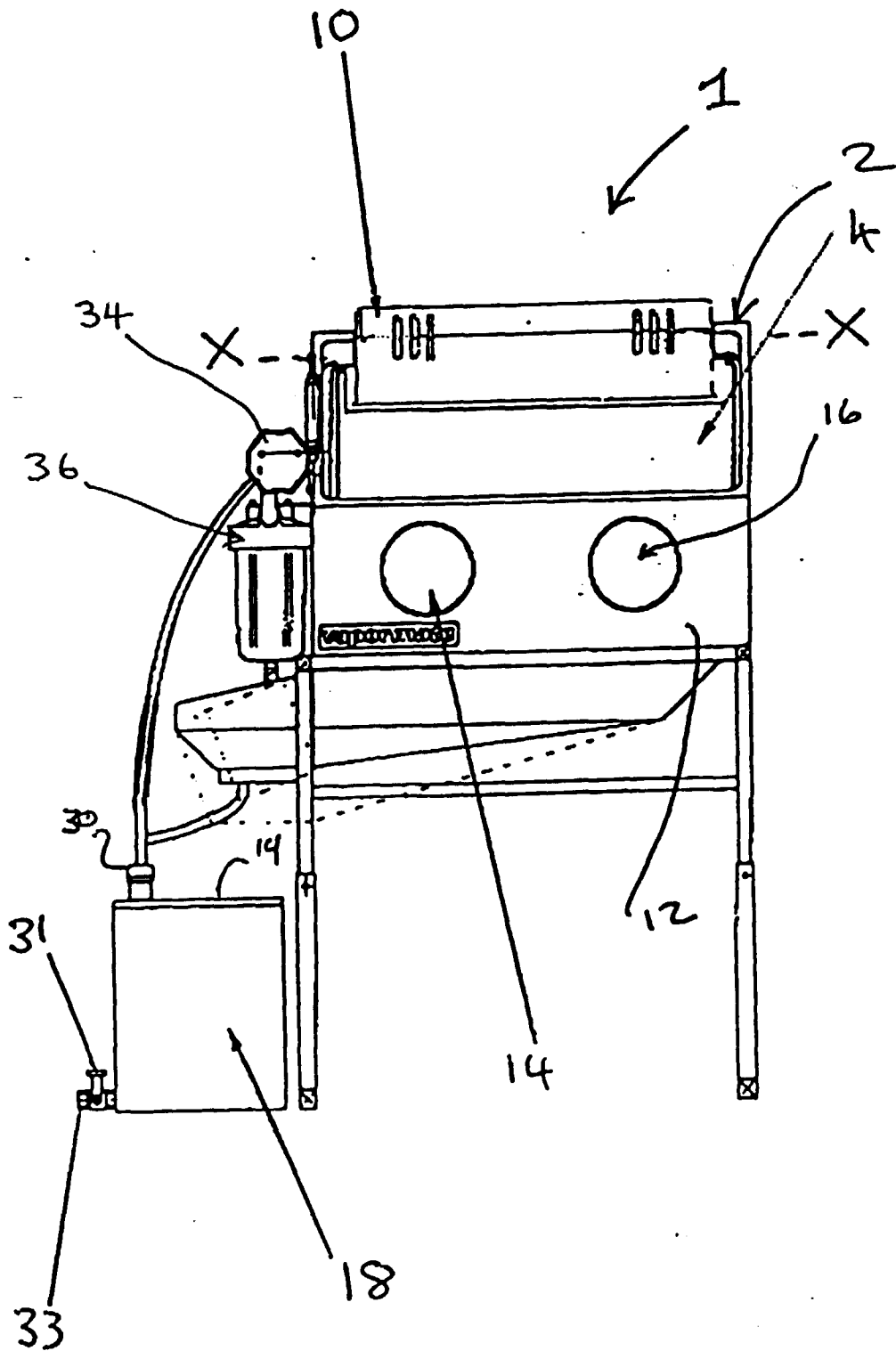


FIG. 3



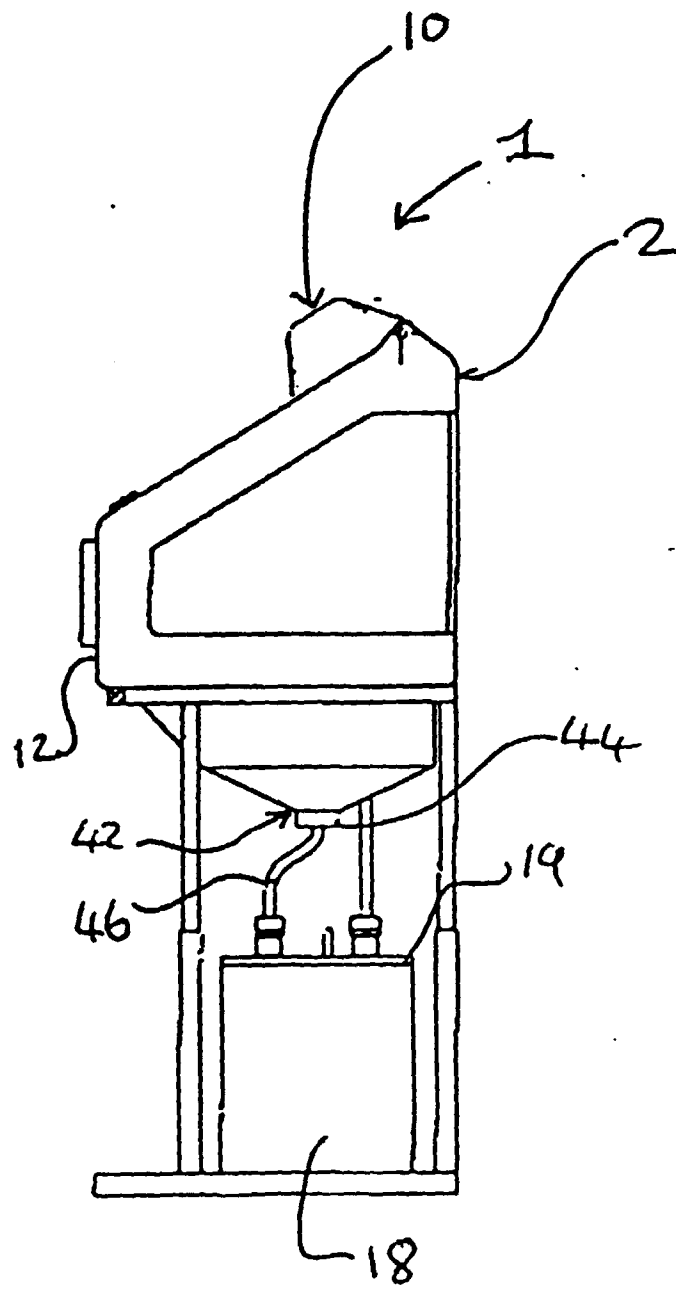


FIG. 5

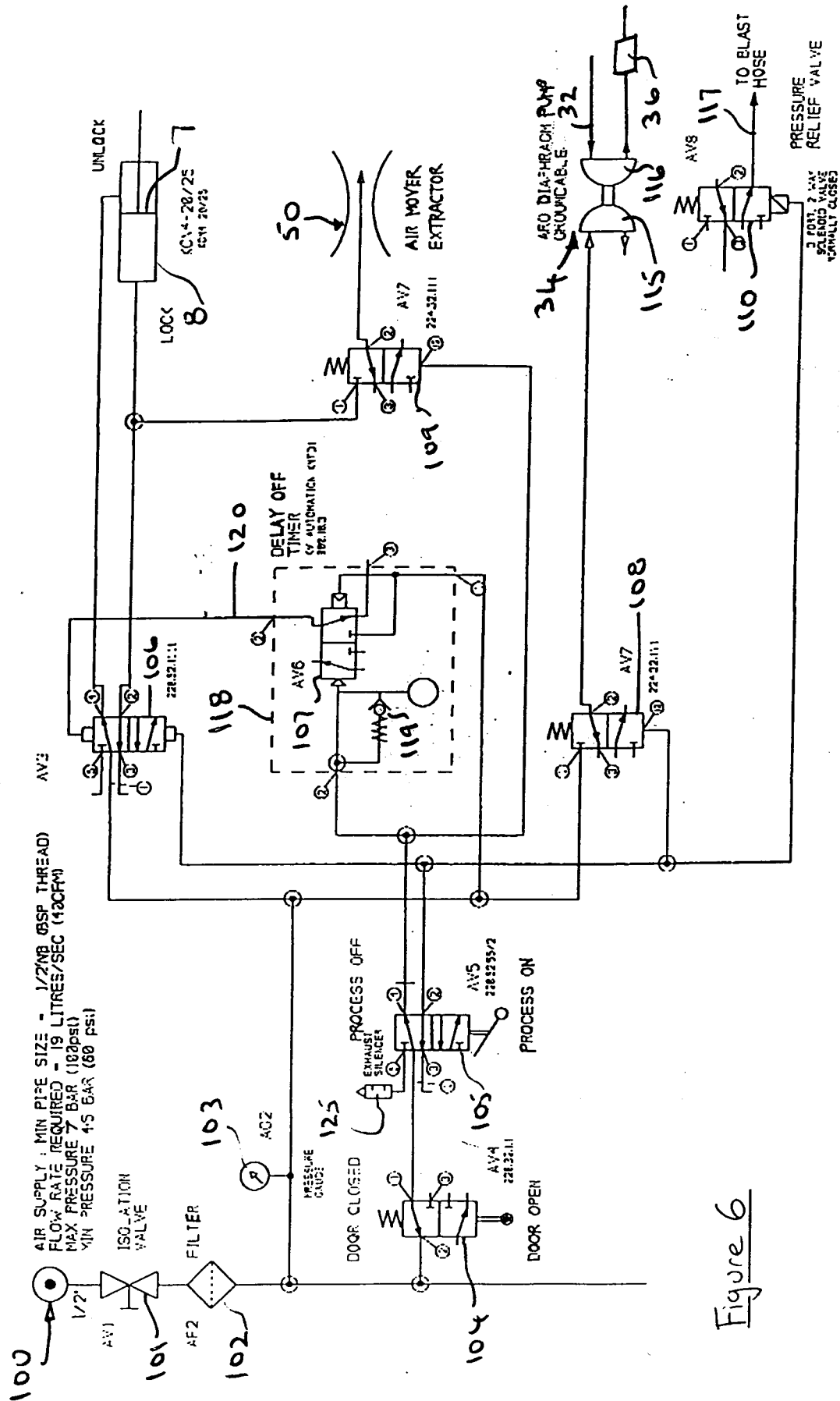


Figure 6

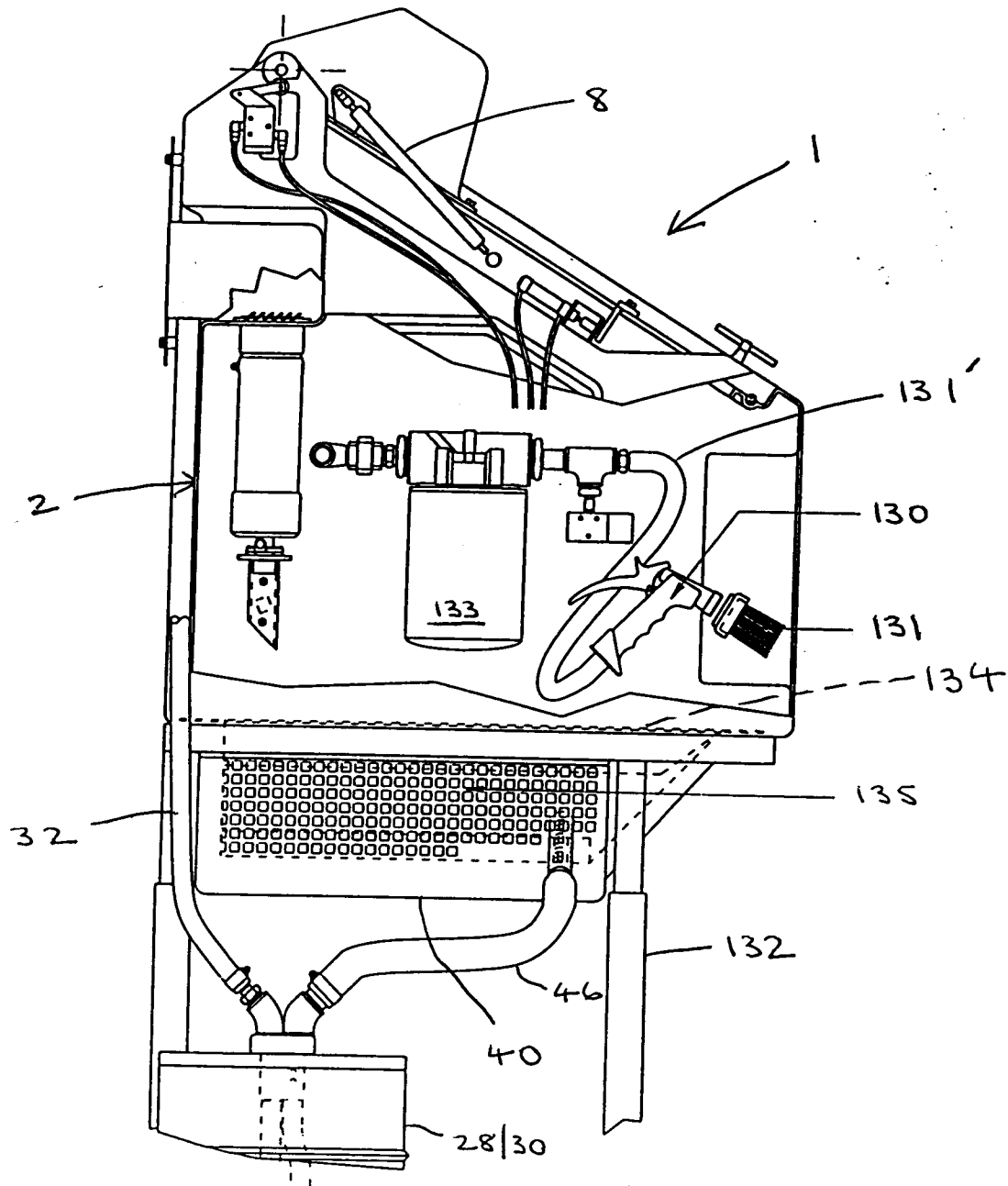


FIG 7

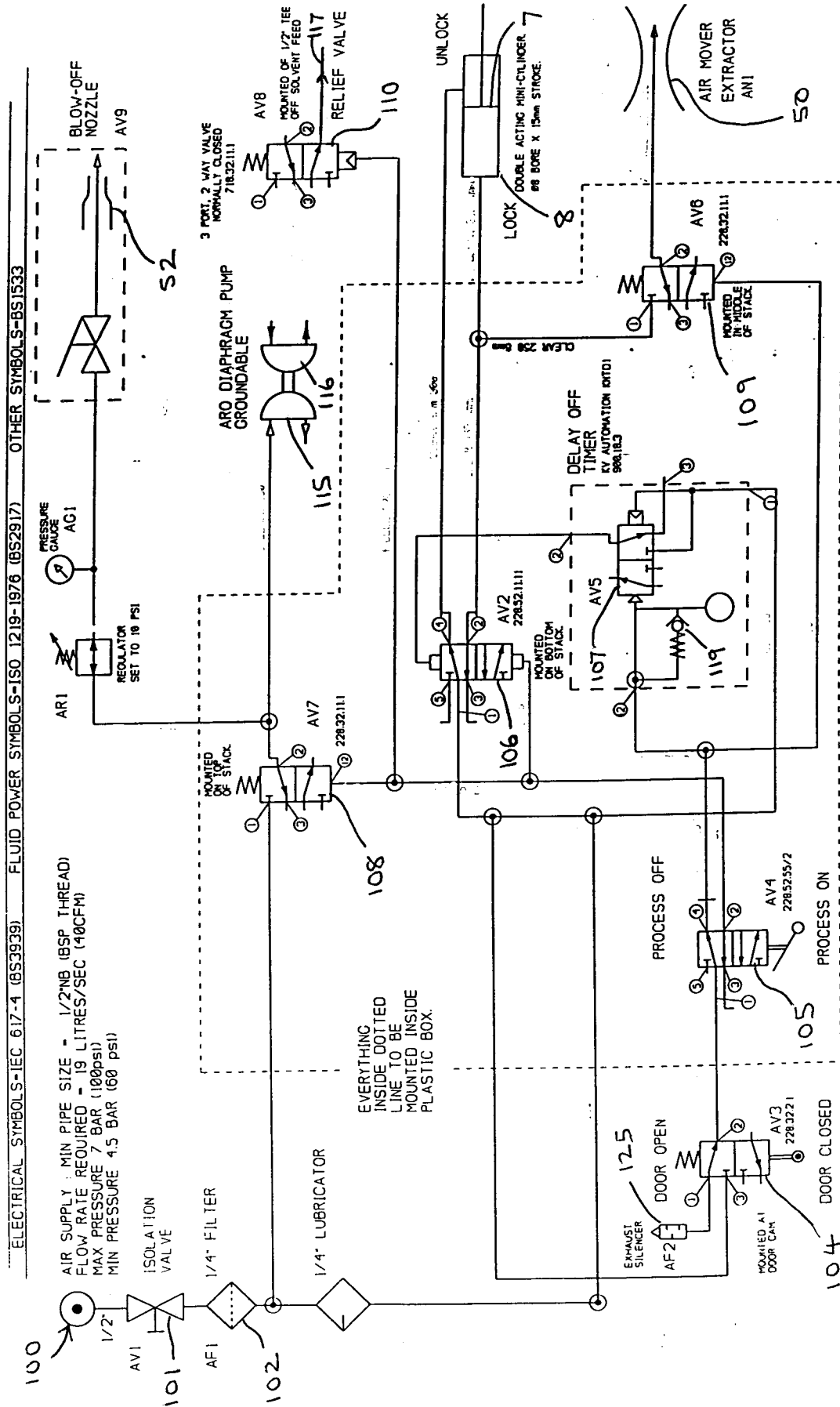


FIG 8