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(54) Method and apparatus for dispensing desiccant materials into window spacer frames.

(57) A method and apparatus for simultaneously filling adjacent sides of a window spacer frame (F) with a desiccant material (D) is characterized by a fill head (18) having a discharge port (56) in communication with a desiccant chamber (20), a releasable clamping device (46,47,49) for clamping the open ends of the adjacent sides in alignment with the discharge port (56), and the pressurization of the chamber (20) with air to force the desiccant material (D) through the discharge port (56) for a time interval (T) necessary to fill the sides of the spacer frame (F). An air conveyor (25) is provided to induce the flow of desiccant material (D) from a reservoir (24) for the purpose of periodically refilling the desiccant chamber (24) when empty, and a fiter system (26,29) in the air conveyor (25) will separate the desiccant material from the air stream while permitting the air stream to be exhausted to atmosphere during the filling operation.

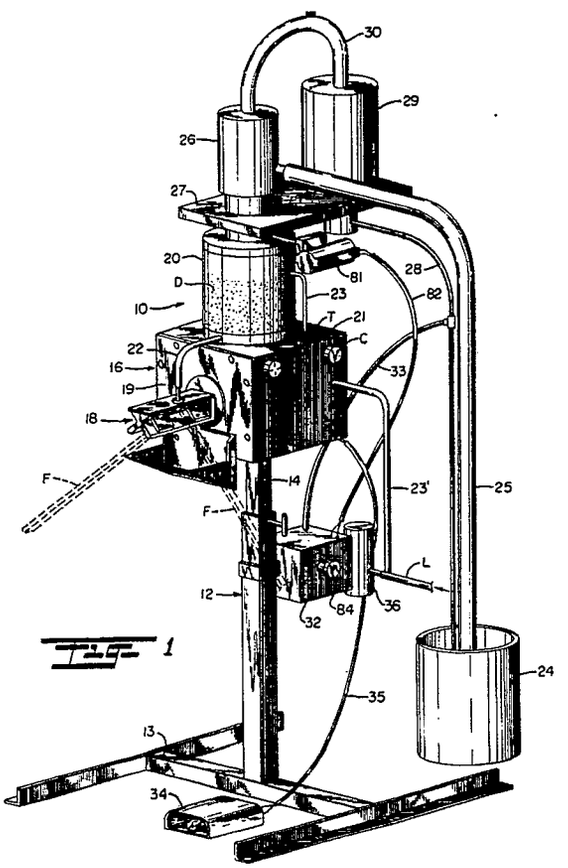

Fig. 1

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METHOD AND APPARATUS FOR DISPENSING DESICCANT MATERIALS INTO WINDOW SPACER FRAMES

This invention relates to dispensing comminuted granular materials, such as, a desiccant material; and more particularly relates to a method and apparatus for introducing desiccant materials under pressure into window pane spacers, such as, hollow aluminum spacer frames employed in the fabrication of insulated glass units.

Desiccant materials are utilized in fine, granular form to fill hollow frames, such as, the hollow spacer frames for insulated glass units in order to minimize the formation of condensation on the inside surfaces between the window panes. Representative of approaches which have been followed in the past is U.S. letters Patent No. 3,183,560 to E. Brichard where a dehydrating agent is introduced under vacuum into a tube. In U.S. letters Patent No. 3,030,673 to H. J. London, a silica gel is introduced into hollow frame sections for a window; and in U.S. Letters Patent No. 4,151,696 to R. N. Knights et al the material is a viscous sealing material which is injected under pressure by means of a pumping unit through a series of injection nozzles. Other patents of interest are U.S. Letters Patent Nos. 2,037,893 to Greenan; 3,280,523 to C. E. Stroud et al; 4,261,145 to H. Brocking; 4,660,271 to K. Lenhardt and 4,698,891 to R. Borys.

Among other problems associated with desiccant filling devices which have been utilized in the past for filling spacer frames is the inability to consistently fill a given space or length of frame in a minimum amount of time. In filling, it is desirable to provide for automated filling of different spacer frame lengths and width irrespective of whether or not the frames are bent prior to filling.

According to a first aspect of the present invention there is provided an apparatus for depositing a desiccant material in particle form into an open-ended hollow frame member characterised in that the apparatus comprises a normally sealed chamber containing a desiccant material; a fill head including a discharge port in communication with the interior of said chamber and having means on said fill head for releasably clamping at least one open end of said frame member in alignment with said discharge port; and means for pressurizing said chamber thereby forcing said desiccant material through said discharge port into said open end of said frame member.

According to a second aspect of the present invention there is provided a method of dispensing a desiccant material in particle form into an open-ended hollow elongated frame member characterised in that the method comprises the steps of depositing the desiccant material into a normally sealed chamber; positioning said open end of said frame member in communication with the interior of said chamber; and pressurizing said chamber with a gaseous fluid thereby forcing said desiccant material under pressure into said frame member.

According to a third aspect of the present invention there is provided a method of dispensing particulate desiccant materials into the open-ended adjacent legs of a window spacer frame member characterised in that the method comprises the steps of depositing the desiccant material into a chamber; positioning the open ends of said legs of said frame member in communication with the interior of said chamber; and pressurizing said chamber with air to simultaneously force the desiccant material into each of said legs of said frame member for a predetermined time period.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a perspective view of an apparatus in accordance with the present invention;

Figure 2 is an enlarged plan view of the fill head of the apparatus shown in Figure 1;

Figure 3 is a side view of the fill head shown in Figure 2;

Figure 4 is a cross-sectional view taken along line 4-4 of Figure 2;

Figure 5 is a cross-sectional view taken along line 5-5 of Figure 3;

Figure 6 is a view taken in the direction of arrow 6 of Figure 5;

Figure 7 is an enlarged view partially in section of the desiccant fill chambers of Figure 1;

Figure 8 is an enlarged sectional view of a lower end of a pick-up tube for the desiccant fill chambers; and

Figure 9 is a cross-sectional view taken along line 9-9 of Figure 7.

Referring in more detail to the drawings, there is illustrated in Figure 1 a desiccant filling apparatus 10 which is broadly comprised of a base 13, a support stand 12 having a telescoping standard 14 and upon which is mounted a control housing 16. A fill head 18 is rotably mounted in one sidewall 19 of the housing 16 for the purpose of receiving adjacent free legs of a rectangular spacer frame member F and filling the legs F with a desiccant material represented at D which is supplied from a chamber 20 mounted on top surface 21 of the control housing 16. A supply tube 22 extends from the lower end of the chamber 20 for the purpose of delivering desiccant particles from the chamber 20 into the fill head, and the chamber 20 is pressurized by selectively admitting air under pressure from line 23.

Typically, the legs of a spacer frame are perforated along their inner edges, and accordingly, a moisture-absorbing or desiccant material is inserted into at least a pair of the legs to absorb any moisture that would condense on the inside surfaces between the two parallel sheets of glass of an insulated glass unit, not shown. A suitable type of desiccant material is an insulating glass absorbent material manufactured and sold by W. R. Grace & Co. of Baltimore, Maryland and is characterized by being a fine bead-like substance. One problem in handling this material, particularly in forcing the material into limited spaces or openings for insulation purposes is its tendency to create dust and to the extent that it can become a health hazard. Thus, while the chamber 20 may be manually filled with desiccant material, it is desirable to provide means for automatically filling the chamber from a larger container or reservoir 24 and in such a way as to be dust-free and completely self-contained. To this end, a pick-up tube 25 extends from the reservoir upwardly into a filter bowl or separator 26 which is mounted on a platform 27 above the chamber 20. In a manner to be described in more detail with respect to Figure 7, a vacuum is established in the reservoir 24 by directing air under pressure through an air line 28 into air amplifiers at the lower ends of the tube 25 and the filter bowl 29.

This vacuum or negative pressure will operate to induce the flow of desiccant material from the reservoir through the pick-up tube 25 into the filter 26. The filter 26 will prevent any of the larger desiccant particles from passing through the connecting tube 30 between the filters 26 and 29. The larger particles of the desiccant material D will therefore be free to advance by gravity into the chamber 20, and any air will pass through the filter 29 and be exhausted to the atmosphere.

As shown in Figures 2 to 6, the fill head 18 comprises an elongated, inverted V-shaped body 40 and a circular mounting plate 38 at the rearward end of the body 40 which is secured to the end of a bolt 41 projecting through the wall panel 19 of the control housing 16. The mounting plate 38 is releasably secured against rotation to the surrounding edge of an opening in the panel 19 by clamping screws 39 which extend through the plate and threadedly engage clamping plates 39′ behind the panel 19 to tighten or lock the plate 38 against rotation. When the clamping screws 39 are loosened, the fill head body and the plate 38 can be rotated for a purpose to be hereinafter described. The body 40 has inclined surfaces 42 on opposite sides which slope or diverge downwardly and away from an upper feed area 44 which receives the lower end of the supply tube 22. A fixed guide block 46 and movable block 47 are disposed on each of the inclined surfaces 42 to define a common entrance 48 for insertion of a leg or side of a spacer frame F. The fixed block 46 has an extension plate 49 which extends across the entrance in spaced parallel relation to each inclined surface 42 so as to define a substantially rectangular space or opening at the entrance for insertion of the spacer frame, as best seen from Figure 6.

Each movable guide block 47 is attached with shoulder bolts 47′ slidable in an elongated slot 50 under the control of a double-acting cylinder 52. Each cylinder 52 includes a piston rod 53 pivotally connected to a slide bar 54 which rides beneath each inclined surface 40 and is connected by the shoulder bolts 47′ to the block 47 to control its movement along the slot 50 toward and away from the fixed block 46 in response to air under pressure directel into one of the pressure lines L_3 and L_4. In this way, the block 47 is selectively movable into a closed position, as shown in Figure 3, to clamp a spacer frame between the blocks 46 and 47 with the upper end of the spacer frame in communication with a discharge port 56 extending downwardly from the feed area 44.

The tube 22 is movable lengthwise of the feed tube 44 into and out of alignment with the supply ports 56 under the control of a double-acting cylinder 62 having air pressure lines L_1 and L_2. A piston rod 63 is pivotally connected to a slide bar 64 with the lower end of the tube 22 affixed to the slide bar for advancement under the control of the piston rod 63. Spring-loaded steel balls 65 yieldingly engage the undersurface of the plate 44 to apply a controlled clamping force to the mating surfaces of the slide valve 64.

Referring in more detail to the air conveyor assembly, as shown in Figures 7 to 9, the lower end of the pick-up tube 25 has an air flow amplifier 70. The air amplifier 70 includes a generally conical plug 71 which is centered within the throat region 72, and air is delivered under pressure through the line 28 to flow through the circumferential inlet 73 and upwardly across the venturi formed between the throat 72 and plug 71 in order to induce upward flow of the desiccant material from the reservoir 24 through the lower open end 74. A bracket 75 is disposed across the opening 74 for the purpose of mounting the plug 71 in centered relation to the throat 72. The desiccant material is drawn with the air through the tube 25 and is fed tangentially into the separator 26 so that the air will follow a circular path tending to draw the desiccant from the air against the wall of the separator and will roll downwardly by gravity through funnel 78 into the desiccant chamber 20. A butterfly valve 80 is positioned across the lower end of the funnel and is controlled by a pneumatic actuator 81, illustrated in Figure 1, to seal off the separator 26 from

the chamber 20 during desiccant fill operations when dessicant is being discharged under pressure from the chamber 20 through the fill head 18. Of course, to refill the chamber 20, the butterfly valve 80 is opened by the actuator 81 which in turn is energized by directing air under pressure by a line 82 from a pilot operated valve, not shown, in the housing 32. A manually operated push button valve 84 on the side of the valve housing 32 provides pilot pressure for operation of the valve for the actuator 81 as well as a valve, not shown, which opens the inlet line L to initiate the air conveyor operation for refilling of the chamber 20.

A second fluid flow amplifier 86 is disposed at the lower end of the filter 29 having a frustoconical plug 87 centered within a generally venturi-shaped throat region 88 and receives air under pressure via the pressure line 28 from the control housing 32. This air is directed into a circumferential recess and caused to pass downwardly through the venturi region 88 to create a negative pressure inducing the air to flow through the filter 29 and overcome any pressure loss across the filter medium 29′. As noted earlier, a minimum velocity of air must be maintained in the pick-up tube 25 in order to carry the largest particles from the desiccant reservoir 25 upwardly into the desiccant chamber; otherwise, lower velocities will transport only the smaller particles or not at all. Accordingly, a minimum outlet pressure from the fluid amplifier 70 is required to overcome the maximum pressure head which will develop as a result of lifting the desiccant through the vertical distance into the desiccant chamber 20.

Referring in more detail to the separator 26, preferably a cyclone separator is employed to separate the desiccant material from the air. By feeding the desiccant in at a tangent, the air flow will follow a circular path through the separator in order to encourage the desiccant to advance outwardly against the wall of the separator and to roll downwardly through the funnel-shaped area 78. A filter screen is mounted in the center of the separator which is coarse enough to allow air and dust particles to exit the top of the separator 26 while blocking the larger desiccant particles. In the filter 29, a cloth bag 29′ may provide filtration down to 40 microns. Also, a filter paper can be inserted to filter out particles down to the order of 5 microns. Accordingly, the air amplifier 86 is mounted at the lower end of the filter 29 to overcome the pressure drop across the filter and to increase the pressure differential across the pick-up tube 25. For the purpose of illustration, one suitable form of air amplifier for the amplifiers and 86 is that sold under the trademark "TRANSVECTOR" by the Vortec Corporation, Cincinnati, Ohio.

The foot valve 34 includes pressure and return lines designated at 35 into the main housing 16 for controlling the desiccant fill operation. When the foot valve 34 is activated, air is directed under pressure from an external compressed air source, not shown, via the inlet line L through a separate pressure line 23′ to the control housing 16. Through suitable valving in the housing 16, the actuation of the foot valve 34 will permit air under pressure to be directed from the pressure line 23′ through the upper tube 23 into the top of the chamber 20 in order to pressurize the desiccant the chamber 20.

In each desiccant fill operation, a fill timer control T on the side of the control housing may be set to regulate the time of each fill; also, a clamping pressure regulator C permits adjustment of the degree of clamping pressure by controlling the amount of air pressure directed into the double acting piston 52 for the slide block 47. Typically, a spacer frame F is of generally rectangular cross-sectional configuration with upper inclined sides or legs terminating in free ends, such as, illustrated in Figure 6. In accordance with well-known practice, it is necessary only to fill two sides of a spacer frame in order to efficiently dry or remove moisture along the window surfaces when installed. Accordingly, the fill timer T will be set to assure introduction of a specific volume or quantity of desiccant which can be loaded under pressure into the two legs of the frame. The legs of the frame are inserted into the entrances 48 on opposite sides of the end 18 followed by depressing the foot valve 34. Sequentially, when the foot valve is activated, it will cause the clamp or slide blocks 47 to be urged against the ends of the spacer frame, advance the fill tube 22 to a position aligned with the ports 56, followed by introduction of air under pressure into the desiccant chamber D to positively force desiccant material through the fill tube 22 into the legs of the spacer frame and for a time period as determined by the fill switch T. When the foot valve 34 is released, the sequence is reversed to interrupt the flow of air under pressure to the chamber 20, retract the supply tube 22 to a closed position, and release the clamping blocks 47. The spacer frame is then removed and a corner splice or plug is inserted into the free ends of the legs of the spacer frame to retain the desiccant within the frame.

It should be noted that throughout each fill sequence the butterfly valve 80 remains in a closed position to seal the chamber 20. However, when the supply of desiccant in the chamber 20 is depleted, the valve 80 is opened by the pneumatic actuator 81 and air under pressure is then introduced through the pressure line 28 to refill the chamber 20 in the manner described. The air conveyor sequence for refilling the chamber is initiated by the conveyor button 84 on the valve housing 32. Of course, it will be appreciated that the desiccant

chamber may be filled manually without the assistance of the air conveyor as described. In addition, the fill head 18 can be rotated within the face plate 19 by loosening the clamps 39, for example, to faciliate handling extended lengths of spacer frames without interference from the floor surface. In certain cases, one side of the fill head 18 may be plugged or blocked off so that the desiccant material is directed only through the raised or upper port 56. Moreover, the adjustable telescoping standard 14 enables suitable height adjustment of the machine according to the size of the spacer frame to be filled.

It will be apparent to those skilled in the art that the described embodiment of the present invention provides a method and apparatus for dispensing desiccant materials and in particular for their introduction under pressure into spacer frames of the type employed in insulated glass units. The method and apparatus described enables desiccant material to be injected in a minimum amount of time at a predetermined pressure and remains flexible enough to be used in filling a wide range of lengths and sizes of spacer frames. Furthermore the described embodiment provides a means for conveying the desiccant material from a bulk packaging container into a chamber which can be pressurized in such a way as to minimize distribution of dust or of wasting or spilling the desiccant material. Finally it will be appreciated that the described apparatus is both modular and transportable while requiring a minimum amount of maintenance.

Accordingly, it is to be understood from the foregoing that various modifications and changes may be made in the construction and arrangement of elements comprising the present invention without departing from the spirit and scope thereof as defined by the appended claims.

Claims

1. Apparatus for depositing a desiccant material (D) in particle form into an open-ended hollow frame member CF), characterised in that the apparatus comprises a normally sealed chamber (20) containing a desiccant material (D); a fill head (18) including a discharge port (56) in communication with the interior of said chamber (20) and having means (46,47,49) on said fill hem (18) for releasably clamping at least one open end of said frame member (F) in alignment with said discharge port (56); and means (23) for pressurizing said chamber (20) thereby forcing said desiccant material (D) through said discharge port (56) into said open end of said frame member (F).

2. Apparatus in accordance with claim 1, wherein said hollow frame member (F) is of generally rectangular configuration having two adjacent sides with adjacent open end portions, said fill head (18) is provided with opposed, downwardly inclined surfaces (42) extending away from said discharge port (56), and said releasable clamping means (46,47,49) releasably clamps said adjacent sides of said frame member (F) against said downwardly inclined surfaces (42) to position said adjacent open end portions in alignment with said discharge port (56).

3. Apparatus in accordance with claim 1 or claim 2, wherein said releasable clamping means (46,47,49) includes a fixed block (46) on one side of the discharge port (56), a slidable block (47) on the opposite side of said discharge port (56), and means (52,53,54) for advancing said slidable block (47) toward and away from said fixed block (46).

4. Apparatus in accordance with claim 2, wherein said fill head (18) is rotatably mounted so as to enable the angle of inclination of said oppositely inclined surfaces (42) to be varied.

5. Apparatus in accordance with any preceding claim, wherein a supply conduit (22) extends between said desiccant chamber (20) and said fill head (18), and means (62,63,64) are provided for advancing said supply conduit (22) between a closed position and an open position aligned with said discharge port (56) for directing desiccant material (D) from said chamber (20) through said discharge port (56).

6. Apparatus in accordance with claim 5, wherein a valve member is interposed between said chamber (20) and said supply conduit (22), and means are provided for selectively opening and closing said valve member.

7. Apparatus in accordance with any preceding claim, wherein there is provided a desiccant storage reservoir (24), and air conveyor means (25) for conveying desiccant material (D) from said reservoir (24) into said chamber (20).

8. Apparatus in accordance with claim 7, wherein said air conveyor means (25) includes a separator (26), air pick-up means (25) for transporting desiccant material (D) from said reservoir (24) into said separator (26), and means (29) for filtering said desiccant material (D) from said air conveyor means (25) to exhaust said air to the atmosphere.

9. A method of dispensing a desiccant material (D) in particle form into an open-ended hollow elongated frame member (F) characterised in that the method comprises the steps of depositing the desiccant material (D) into a normally sealed chamber (20); positioning said open end of said frame member (F) in communication with the interior of said chamber (20); and pressurizing said chamber (20) with a gaseous fluid thereby forcing said desiccant material (D) under pressure into said frame member (F).

10. A method in accordance with claim 9, wherein said chamber (20) is pressurized to a pressure level of the order of 20 psi to 45 psi.

11. A method in accordance with claim 9 or claim 10, including the step of releasably clamping said frame member (F) in position with respect to said chamber (20).

12. A method in accordance with claim 11, wherein said open end of said frame member (F) is clamped in alignment with a discharge port (56) which communicates with the interior of said chamber (20).

13. A method in accordance with claim 11, wherein adjacent open ends of said frame member (F) are releasably clamped in communication with the interior of said chamber (20) and simultaneously filled with desiccant material (D).

14. A method of dispensing particulate desiccant materials (D) into the open-ended adjacent legs of a window spacer frame member (F) characterised in that the method comprises the steps of depositing the desiccant material (D) into a chamber (20); positioning the open ends of said legs of said frame member (F) in communication with the interior of said chamber (20); and pressurizing said chamber (20) with air to simultaneously force the desiccant material (D) into each of said legs of said frame member (F) for a predetermined time period (T).

15. A method in accordance with claim 14, wherein the open ends of said legs are positioned in alignment with normally closed discharge ports (56) communicating with said chamber (20) and said ports (56) are opened to inject the desiccant material (D) simultaneously into said legs.

16. A method in accordance with claim 15, wherein said legs are releasably clamped in alignment with said discharge ports (56).

17. A method in accordance with any of claims 14 to 16 including the step of bending said frame member (F) into a generally rectangular configuration prior to injecting said desiccant material (D) into said adjacent legs.

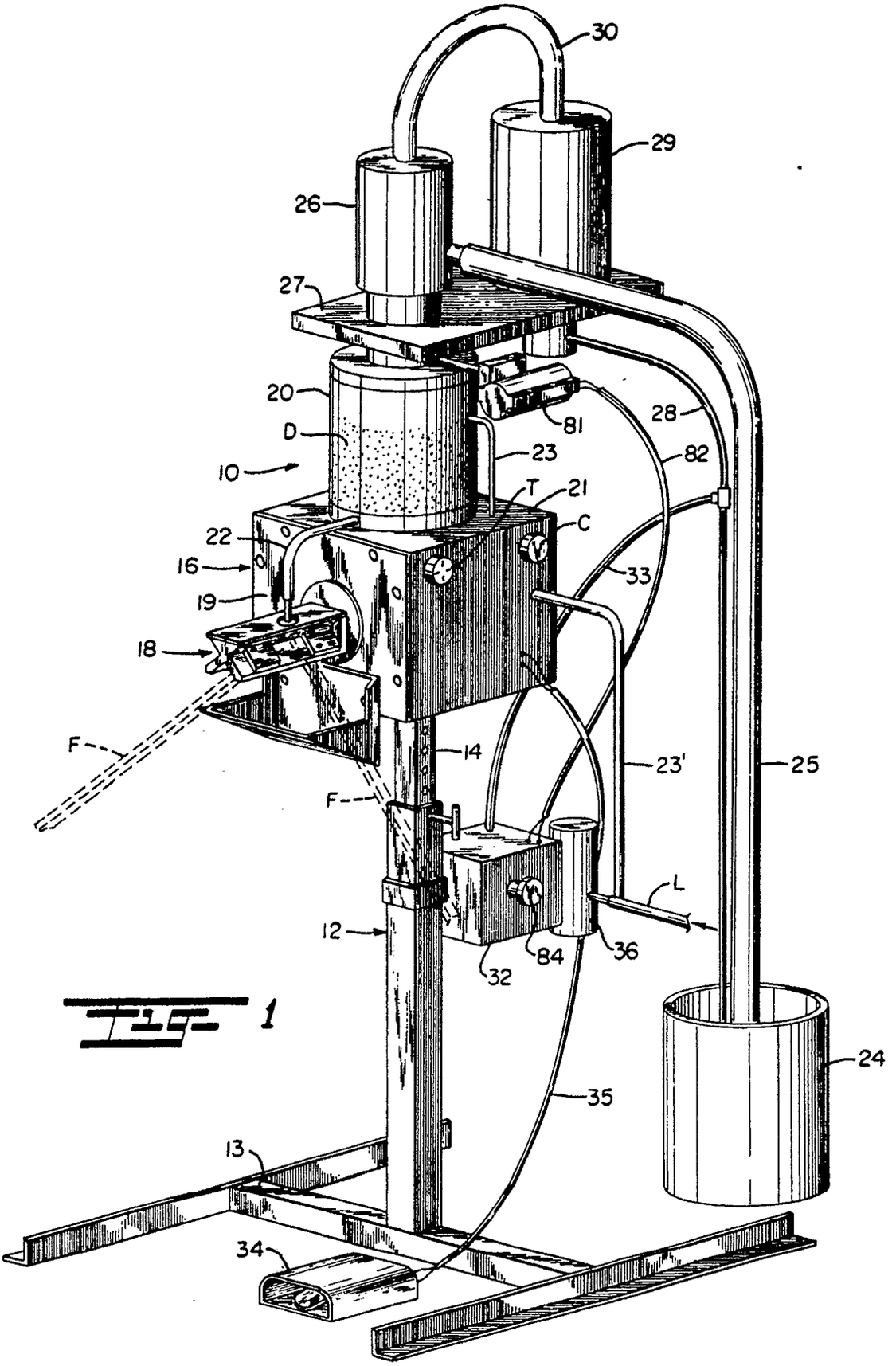
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Fig. 1

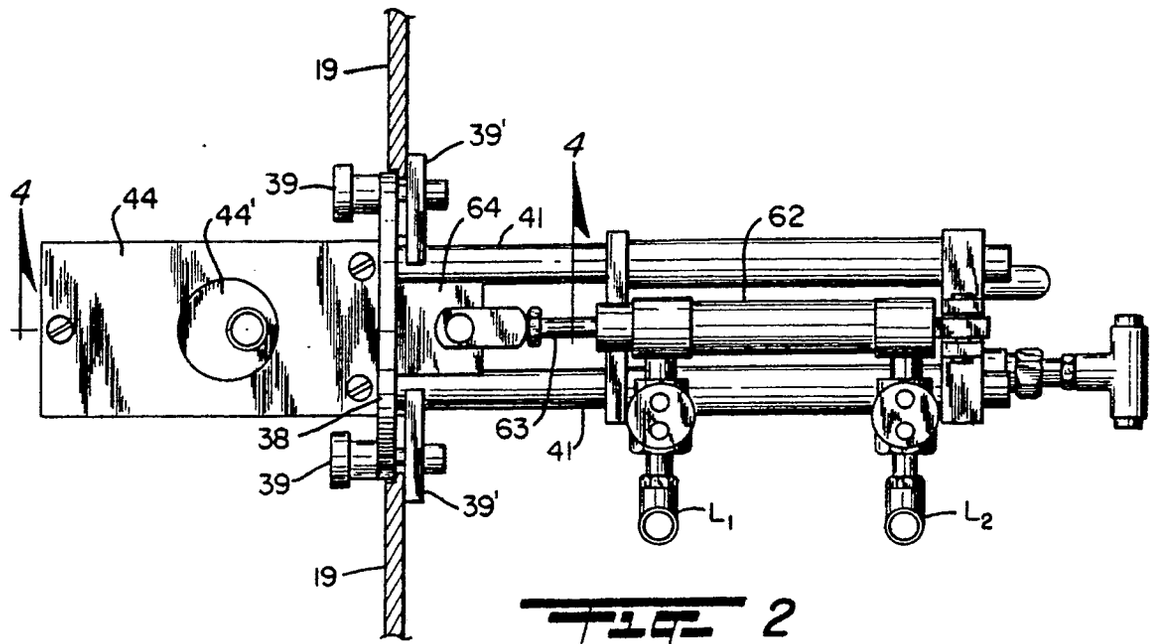

FIG 2

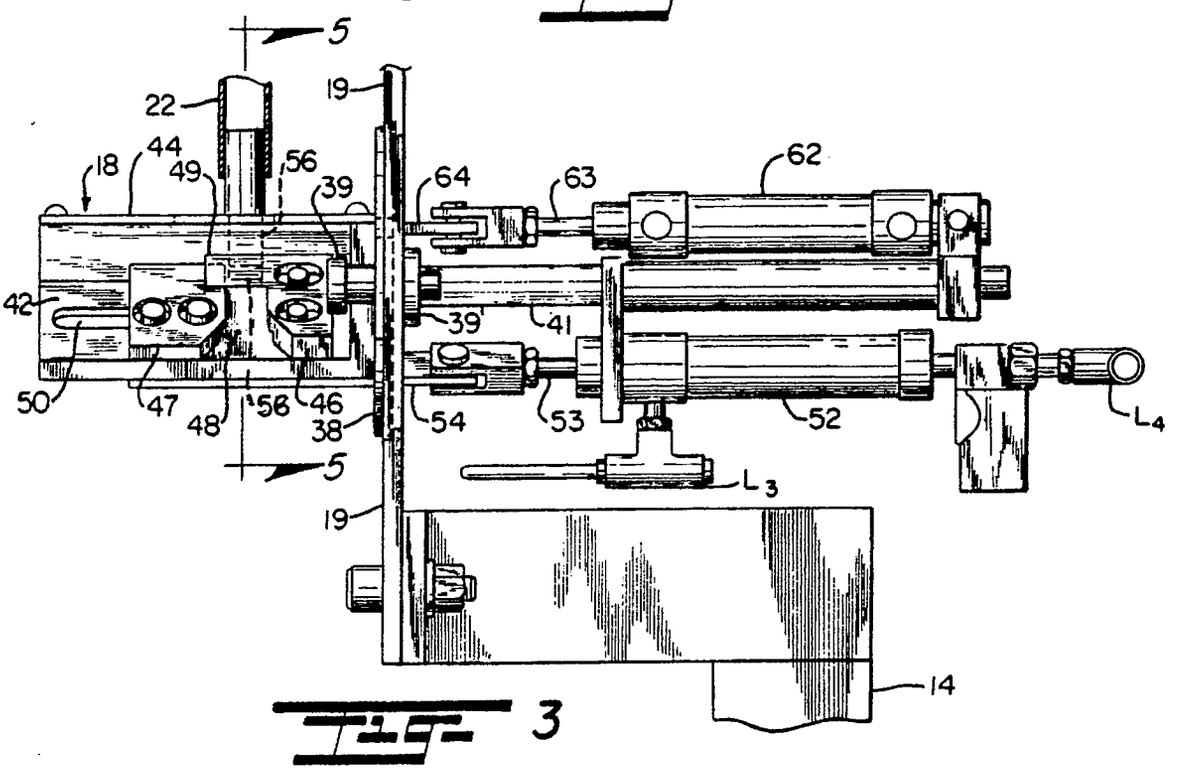

FIG 3

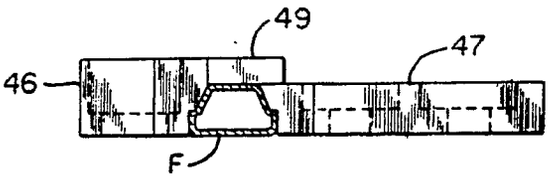

FIG 6

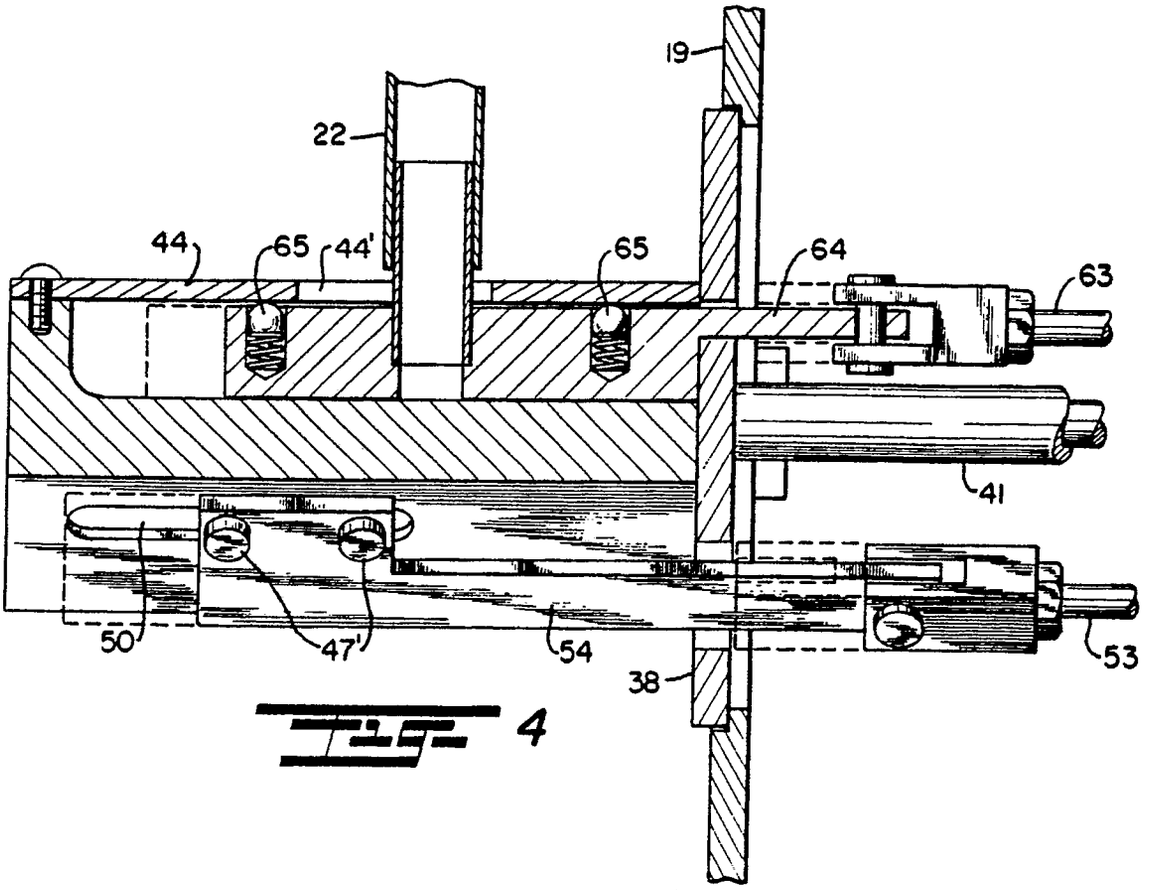
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FIG 4

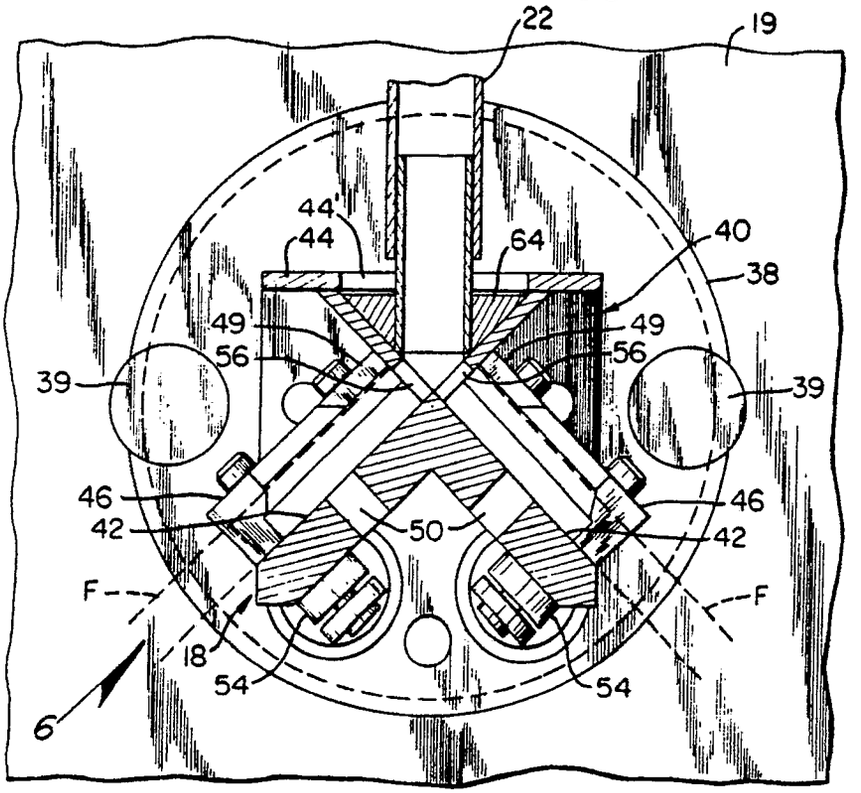
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FIG 5

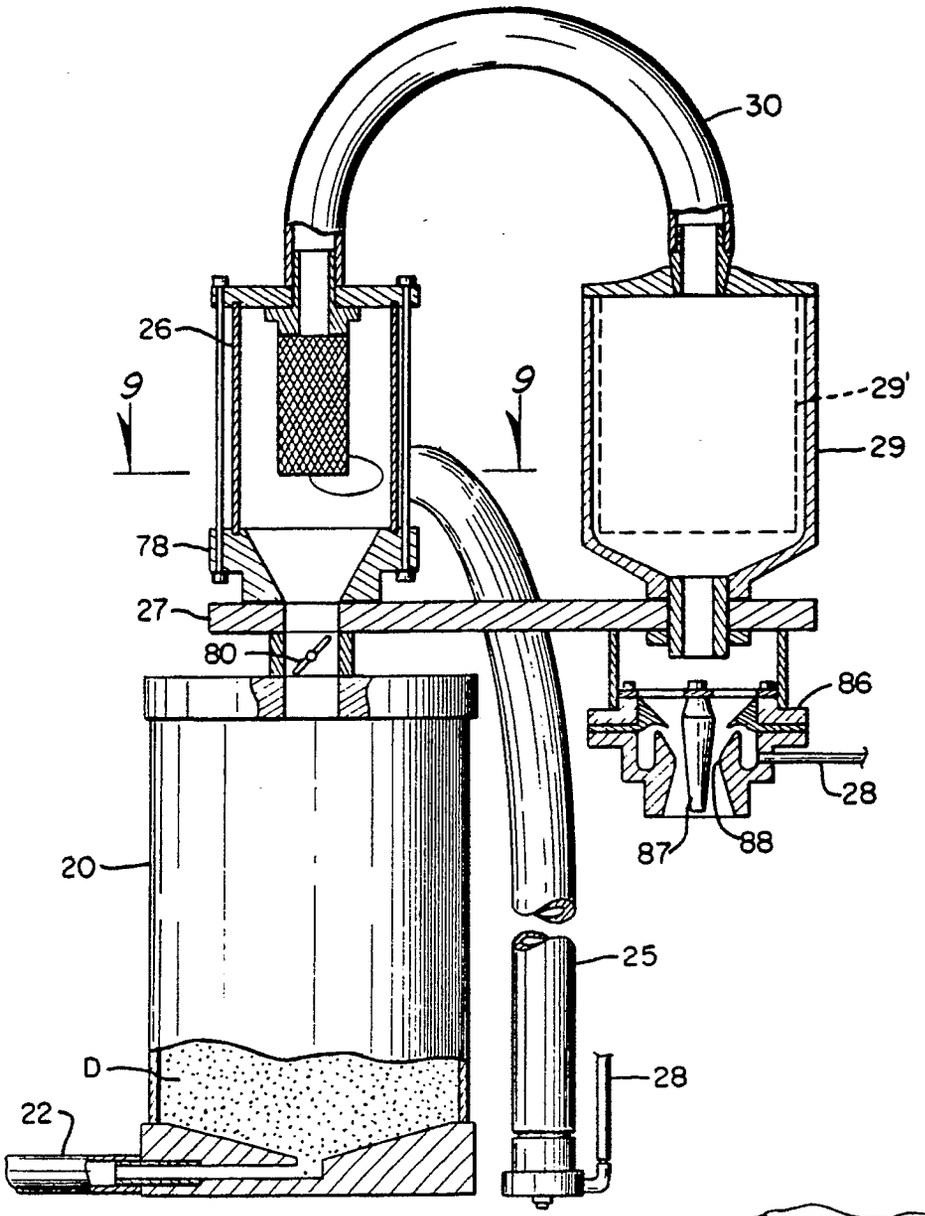

Fig. 7

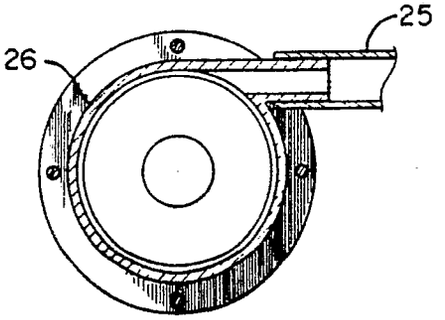

Fig. 9

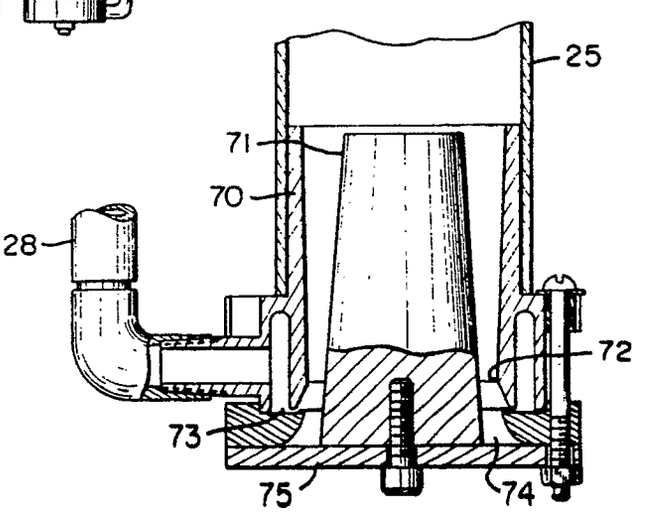

Fig. 8