United States Patent

[11] 3,619,353

[72] Inventor John Covington Williams
Meriden, Conn.

[21] Appl. No. 761,068
[22] Filed Sept. 20, 1968
[45] Patented Nov. 9, 1971
[73] Assignee AMF Incorporated

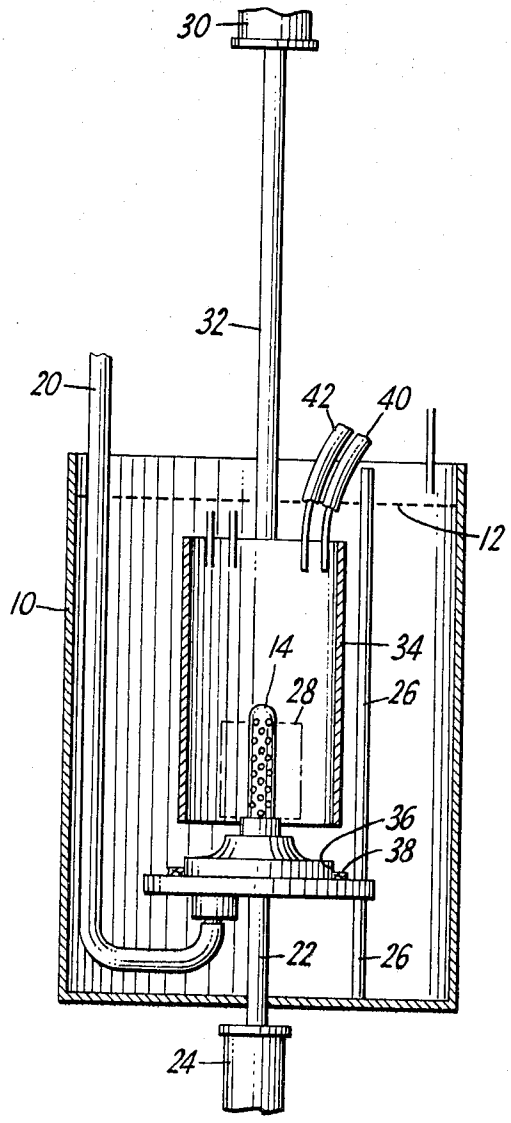
[54] **METHOD AND APPARATUS FOR MOULDING MULTILAYERED FIBROUS ARTICLES HAVING LAYERS OF DIFFERENT FIBROUS MATERIALS**
7 Claims, 11 Drawing Figs.

[52] U.S. Cl. 162/129, 162/219, 162/228, 162/390, 162/407
[51] Int. Cl. D21j 7/00
[50] Field of Search 162/219, 218, 387, 388, 389, 390, 385, 382, 407, 228, 129; 210/496

[56] References Cited
UNITED STATES PATENTS
1,918,782 7/1933 Randall 162/219

Primary Examiner—S. Leon Bashore
Assistant Examiner—Richard H. Tushin
Attorneys—George W. Price and Murray Schaffer

ABSTRACT: Apparatus and method for pulp moulding a fibrous article including a tank containing a first slurry of fibrous material, a foraminous die connected to a rod and cylinder for moving the die into and out of the first slurry in the tank on which the article is formed, a sleeve connected to a rod and cylinder for moving the sleeve into and out of the first slurry in the tank, the sleeve functioning to isolate the die from the first slurry in the tank, and hoses connected to the sleeve for supplying a second slurry of fibrous material to the area between the sleeve and the die in order that the accreted product be composed of layers of varying fiber constituents.



PATENTED NOV 9 1971

3,619,353

SHEET 1 OF 3

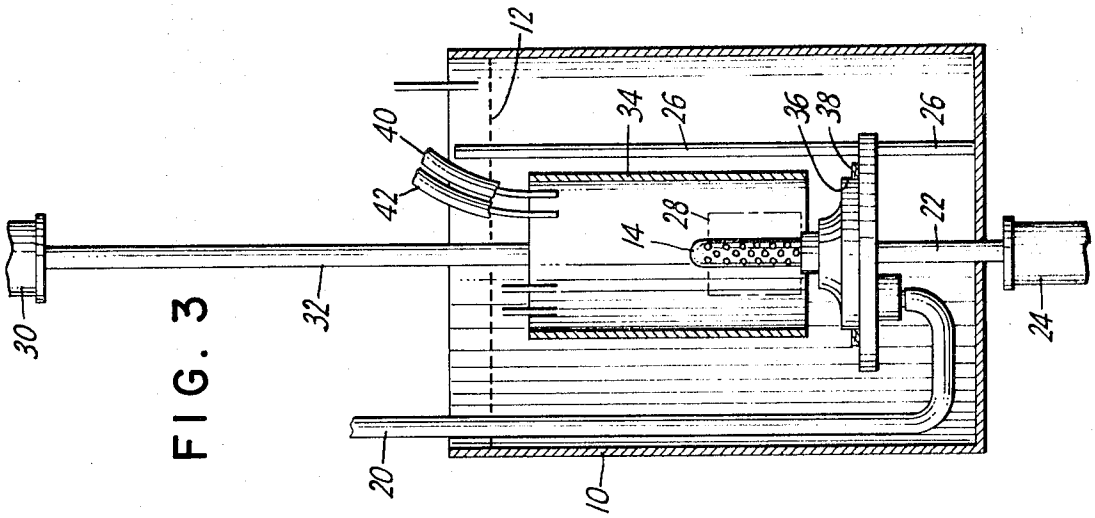


FIG. 3

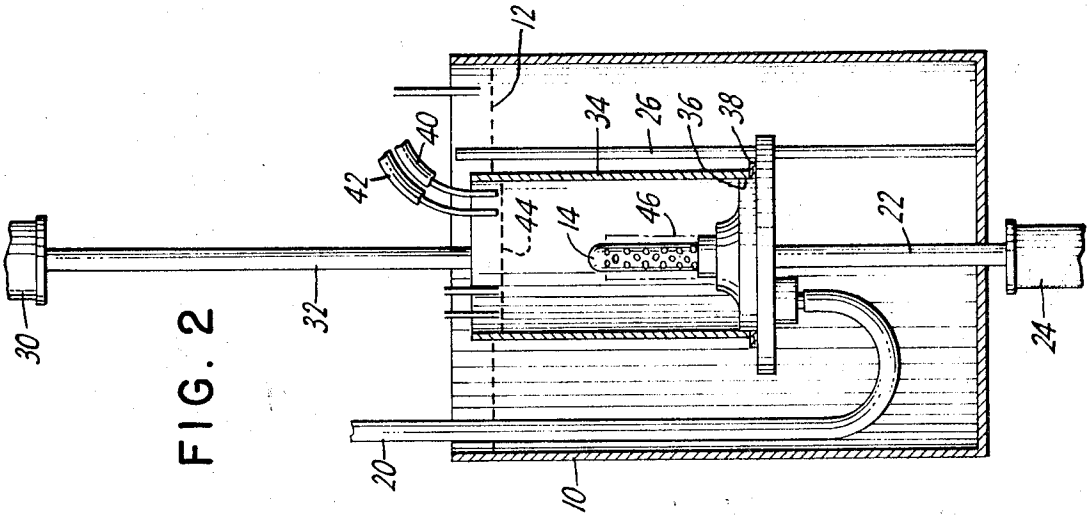


FIG. 2

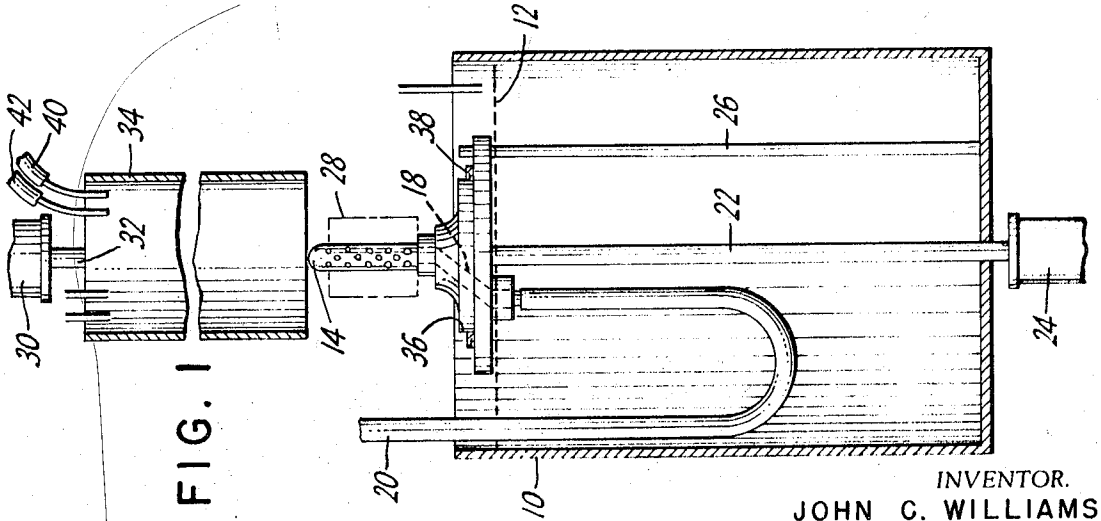


FIG. 1

INVENTOR.
JOHN C. WILLIAMS

BY

ATTORNEY

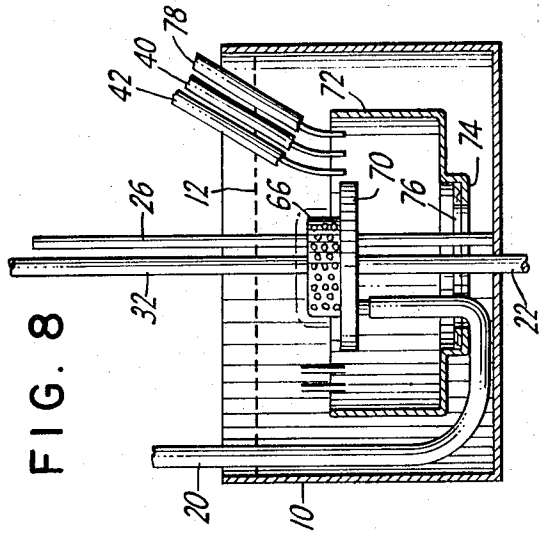


FIG. 8

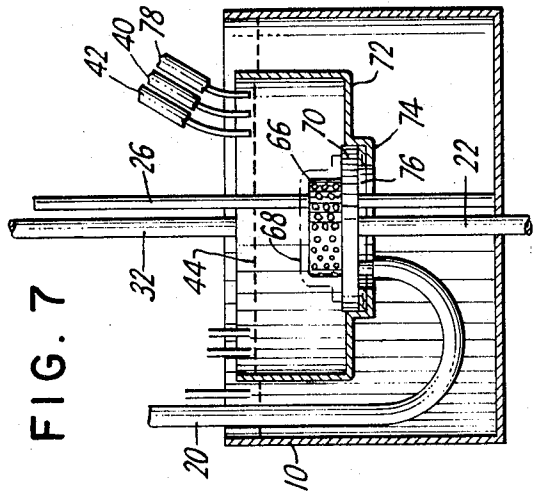


FIG. 7

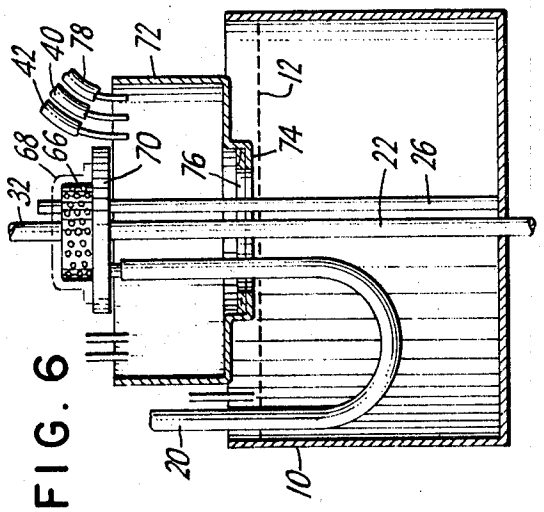


FIG. 6

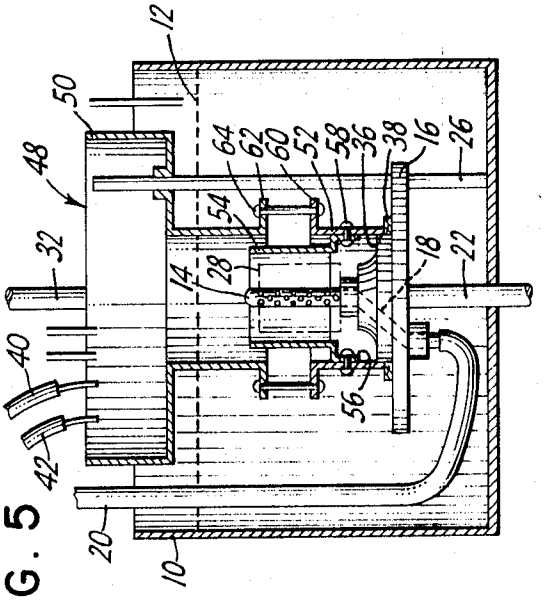


FIG. 5

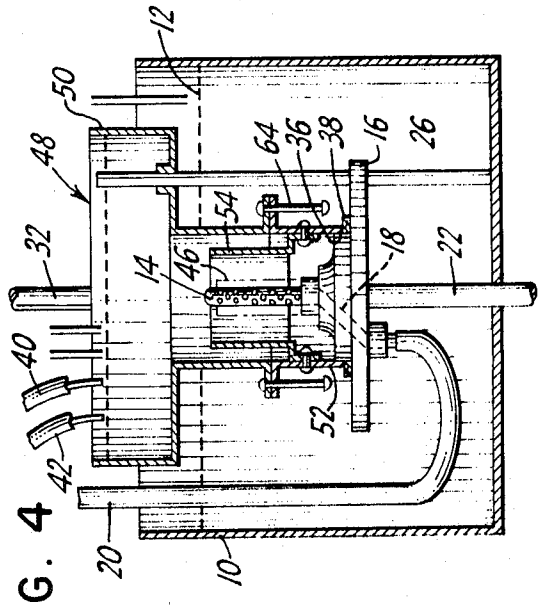


FIG. 4

INVENTOR.
JOHN C. WILLIAMS

BY Murray Schaffer

ATTORNEY

FIG. 11

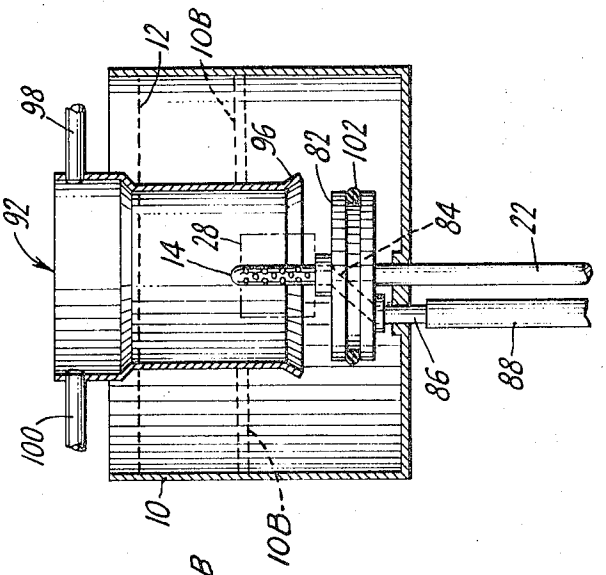


FIG. 10

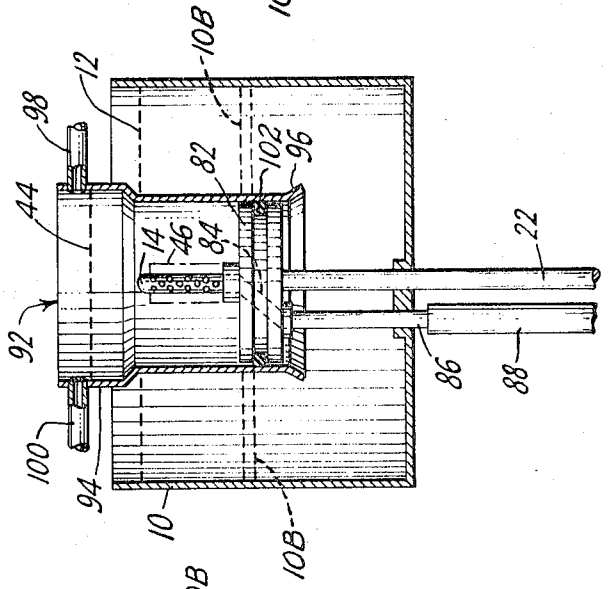
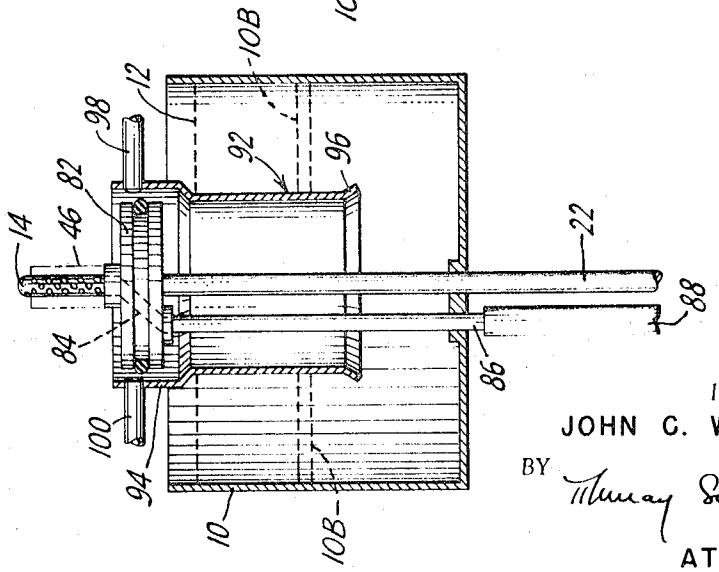


FIG. 9



INVENTOR.
JOHN C. WILLIAMS
BY Murray Schaff
ATTORNEY

METHOD AND APPARATUS FOR MOULDING MULTILAYERED FIBROUS ARTICLES HAVING LAYERS OF DIFFERENT FIBROUS MATERIALS

The present invention concerns the art of pulp moulding, and in particular the method and apparatus for accreting fibrous products.

Various products such as filter cartridges, egg boxes and other formed protective packaging, or structural panels have been moulded by the accretion of such constituents as vegetable, animal, or nonorganic fibers which were first cut to suitable length and dispersed in a liquid vehicle. A foraminous former or mould is inserted in the dispersion or slurry of fibers and a vacuum drawn therethrough. The fibers are consequently deposited on the former until the desired wall thickness and shape is obtained. The former, with product is then removed, the product being dried and finished as desired.

Attention is drawn to U.S. Pat. Nos. 2,539,767 and 2,539,768 to Anderson which were owned by the assignee of this invention and which describe in detail the making of a thick-walled tubular filter element having graduated porosity, with pores increasing in size from the inner surface to the outer surface. These patents, however, describe a method and apparatus in which control of the gradation of the porosity of the accretion, its wall formation and constituent content is missing.

The prior art shows many attempts to accrete products having walls of controlled varied characteristics but the means thereof have been highly specialized and cumbersome in construction and somewhat inflexible in the range of articles produced, in that it has been virtually impossible to change constituents during felting, vary the pore gradation of the product or vary the wall composition of the product during the process. At present, in order to obtain these effects a partially finished product must be made, removed from the dispersion and placed into a second dispersion of a different fiber constituent, different vacuum and under control of a different former.

It is accordingly an object of the present invention to provide method and accretion apparatus capable of producing a wide range of products particularly those whose walls have predetermined nonuniform physical characteristics.

A further object is to provide a method permitting the transition from one constituent (i.e., fiber) of an accretion to another at a controlled rate, i.e., the transition may be abrupt and without appreciable comingling of the constituents or it may be very gradual, even to the point of an incomplete substitution of one constituent for another.

Another object is to afford a method of multilayer accretion permitting the localized modification of the depth of accretion.

It is also an object of the invention to provide a means and a method of accreting multifibrous products without necessitating the emergence into the air of an incomplete moulding from a liquid bath during the process involved.

The above objects as well as numerous other objects and advantages will be apparent from the following description in which:

FIG. 1 is a schematic diagram of one form of apparatus suited to the accretion of multicomponent thick-walled tubular filter elements, with the mechanism in the unloading position;

FIGS. 2 and 3 show the same apparatus in two different accreting positions;

FIGS. 4 and 5 show a variant of the mechanism of FIGS. 1, 2 and 3 in the positions assumed in two stages of its accreting cycle and are comparable to FIGS. 2 and 3;

FIGS. 6, 7 and 8 show a slightly different apparatus in the same relative positions as the mechanism of FIGS. 1, 2 and 3;

FIGS. 9, 10 and 11 show another embodiment of the invention in the same relative positions shown in FIGS. 1, 2 and 3.

The apparatus of FIGS. 1, 2 and 3 comprises a conventional accreting tank 10, containing a suitable fiber-bearing slurry 12. A foraminous former or die 14 is carried on base 16 and

connected via passage 18 to a suction hose 20. The base 16 is secured to an elevator rod 22 which may conveniently be the piston rod of an ordinary hydraulic cylinder 24. One or more guides 26 are provided to maintain the base 16 in its proper orientation. In FIG. 1 a completed accretion indicated as 28, is ready for removal for such further processing as may be needed.

As so far described the accretion apparatus comprises components which will be recognized from the aforementioned patents. Their function is making accreted articles are well known. For the sake of brevity we have omitted various details found in the aforementioned patents, as well as others dealing with such items as the specific constructional configuration, control drives, valves, etc. since their description here is unnecessary for a complete understanding of this invention.

In accordance with the present invention there is located above the accretion tank, and supported by suitable structure (not shown) an elevating mechanism comprising, preferably, a hydraulic cylinder shown in part as 30, having a piston rod 32, to which is attached a surrounding sleeve 34. The sleeve may be made of any conventional material such as metal or synthetic plastic. The inside diameter of the said sleeve is adapted to be slipfit on a register 36 supported on base 16 and to seal with a gasket 38. The gasket 38 is shaped and adapted to form a fluid seal between the sleeve 34 and the base 16 so that when the sleeve is placed over the die 14 (in operating condition FIG. 2) the die may be isolated from the contents of tank 10. A pair of flexible hoses 40 and 42, are secured to sleeve 34 and serve, respectively, to supply water and a second slurry 44 disimilar to the earlier mentioned slurry 12. The slurries 12 and 44, as well as the source of suction are not shown as they may be of any convenient form.

It will be apparent however that the construction shown permits a variety of uses not obtainable with the prior art devices. For example; the sleeve 34, may be placed over the former or die 14, at any preselected and predetermined time during the cycle of operation to isolate the former 14 and the accretion thereon from the slurry 12 in the main tank and to thereby define a smaller tank 10*a* to which a second and different slurry may be fed. Thus conversion from one fiber constituent to another may be made without any break in the operating cycle and without removal of the accreted moulding from the slurry bath. Of course, the procedure from one tank to another may be reversed if desired. Further by successively lowering and raising the sleeve 34 successive and alternating layers of different constituent fibers may be deposited on the die 14.

As a specific example, the present device may be used to make a filter element having a core of one fiber and an overlay of another. With slurry 12 at its working level and consistency and the former 14 unloaded (see FIG. 1) the sleeve 34 is lowered over register 36 and into sealing contact with the gasket 38 by appropriate cooperation of cylinder 30. The base 16 and the said sleeve are then lowered together by simultaneous operations of cylinders 24 and 30, the position indicated in FIG. 2, without entry of slurry 12 into the sleeve. Slurry 44 is next fed through hose 42 to a suitable level in the sleeve 34 and suction applied to die 14 through hose 20. The fiber content of slurry 44 is consequently accreted onto the die. During this step, the die may be kept submerged, by the addition of more slurry 44 or of water through hose 40 or of the addition of both, until the inner core 46 has been formed to a desired thickness. Thereafter, without shutting off the suction and while keeping the die submerged, the base 16 and sleeve 34 may be lowered further into slurry 12 to the positions shown in FIG. 3. Simultaneously, the supply of slurry 44 and/or water if used are shut off. The material from slurry 12 is next deposited on inner core 46 until just prior to completion of the accretion 28. The sleeve 34 is then lowered into sealing relationship with gasket 38 and then is raised together with base 16 until the latter takes the position shown in FIG. 1; during this time suction has been maintained through hose 20. As soon as the slurry remaining in the sleeve above the bottom end of die 14 has

been drawn off, the sleeve is raised to the position shown in FIG. 1 and, after removal of the thus completed accretion 28, a new operating cycle may be initiated.

FIGS. 4 and 5 show a second form of the present invention. Structure equivalent to that shown in FIG. 1 is omitted as redundant because the only difference lies in the form and movement of the isolator sleeve. In this construction an isolator sleeve 48 is provided which comprises a bowl 50 and a lower tubular portion 52. The upper bowl 50 is severed by suitable webbing to the piston rod 32 and is adapted to move vertically. A baffle 54 carried on arms 56 is secured by rivets 58 or other convenient fastenings to the lower portion 52. The lower portion 52 is also provided with an annular flange 60, arranged for sealing engagement with a corresponding flange 62 formed along the lower lip of the bowl 50. A gasket, not shown, may be used at this point as a seal if necessary. The two flanges are loosely tied together by a series of head pins 64 to allow limited axial separation between the upper bowl and the lower tubular portion. The lower end of said portion is, as in the case of sleeve 34 slip fit on register 36, while gasket 38 seals the joint therebetween. Hoses 40 and 42 are secured to bowl 50 and used as before described to furnish water and slurry 44.

With this particular construction, at the start of the accretion cycle, the isolator sleeve 48 is held in the air above die 14 in elevated position similar to that shown in FIG. 1. With slurry 12 at its working level, the sleeve 48 is lowered over register 36 and held so that gasket 38 and flanges 60 and 62 afford their sealing functions and the isolator is sealed against intrusion of slurry 12. The above-mentioned parts are lowered to the position shown in FIG. 4, and a suitable quantity of slurry 44 is furnished. Suction is applied and the inner core 46 accreted in the manner previously described. When the inner core 46 has been completed the base 16 together with portion 52 is lowered to the position shown in FIG. 5 separating the upper bowl 50 from the lower portion 52. Slurry 12 is now free to enter the previously sealed isolator sleeve 48, and the remainder of the accretion cycle calling for the deposition of a second constituent may be completed. The baffle 54 serves only to protect the growing accretion against direct radial impingement of slurry 12 which, in some cases, might have an objectionable washing action on the growing product. The baffle 52 may if desired be eliminated or replaced with other suitable structure. On completion of the accretion 28, the base 16 is moved up so that the gap between flanges 60 and 62 is closed and the motion is continued to carry base 16 clear of the contents of tank 10, thereafter the isolator 48 is moved still further upward to allow access to die 14 and, when the accretion 28 has been removed, a new cycle may be initiated.

FIGS. 6, 7 and 8 show another embodiment of the invention. It comprises a tank 10, slurry 12, suction hose 20, elevator 22 operated by cylinder 24 (not shown), one or more guide rods 26, a piston rod 32 operated by cylinder 30 (not shown) water and slurry hoses 40 and 42 and slurry 44, all serving in the manner previously described. The embodiment also comprises a foraminous die 66 connected to suction hose 20 and, exemplarily, suited to the accretion of a shallow tray schematically indicated at 68. The die is supported on base 70 carried on elevator 22 and guided in its movement by rod 26. An isolator sleeve 72 made in the form of an open bottom tank is secured to piston rod 32 for vertical movement. The opening in the bottom of isolator sleeve 72 has an annular flange 74 and carries a gasket 76 for forming a fluid tight joint between said flange and the underside of base 70 when the latter is in the position shown in FIG. 7. A third hose 78 is carried by the sleeve and serves to supply a third slurry 80 which may differ in its makeup from the earlier mentioned slurries 12 and 44. For the purpose of illustrating the flexibility of the invention, it is assumed that the tray 68 comprises three layers of accreted material, the inner one, from slurry 44 being an ornamental colored fiber, the second or intermediary layer, from slurry 12, of a low cost bulky material and the outer one being of an abrasion resistant material 80 with a high resin content. The sequences mentioned have been chosen arbitrarily and not as representing limitations of the apparatus.

At the start of an accretion cycle the sleeve isolator 72 is held on elevator rod 32 above the slurry 12 and the die 66 on its base 70 is held above the isolator, as shown in FIG. 6, affording easy access to said die. With slurry 12 at its working level, the base is lowered into sealing engagement with the gasket 76 and the above-mentioned parts are then lowered to the position shown in FIG. 7 when suitable amount of slurry 44 is run into the isolator and accreted on to die 66 in the usual manner. As the quantity of slurry 44 approaches exhaustion, the isolator 72 is lowered to the position shown in FIG. 8 giving slurry 12 access to the die 66. When almost all of the required quantity of material from slurry 12 has been deposited on to the die, the isolator is returned to the position shown in FIG. 7, the quantity of slurry 12 remaining in the isolator being sufficient to complete the deposit of its material. At this point slurry 12 may be completely drawn off and water from hose 40 used to prevent the incomplete accretion going dry prior to initiating the flow of slurry 80 from hose 78 or, alternatively, slurry 80 may be used to prevent the emergence of the partially formed accretion. After completion of the accretion by deposition of material from slurry 80, the flow of the latter is cut off and the isolator and die are raised to the position shown in FIG. 6 when the accretion may be removed and a new cycle started.

A multislurry accreting mechanism comprising another embodiment of the invention is shown in FIGS. 9, 10 and 11 which show the same operational steps as the earlier described FIGS. 1, 2 and 3. This arrangement has an accreting tank 10, slurry 12 and die 14 as previously disclosed; the die is carried on to base 82 and is connected by passage 84 to a suction hose 86 through the connector 88 here shown as a sliding fit in gland 90. The isolator 92 is tubular in form and has an enlarged diameter or bell 94 at its upper end and a flare 96 at its lower end which serves as an entrance guide for base 82. A pair of connectors 98 and 100 are secured to the said bell to supply water and a slurry 44 respectively in the manner described. The isolator 92 is secured rigidly to tank 10 by any convenient means such as brackets indicated at 10B in FIGS. 9. 10 and 11, and does not move, thus dispensing with the cylinder 30 and piston rod 32 of the previously described embodiments.

The object deposited onto the die 14 may be illustrated as before by an inner core 46 and as a complete accretion 28. The operating cycle is as follows: with slurry 12 at its operating level and die 14 raised and empty (see FIG. 9), the die 14 with its base 82 are lowered to the position shown in FIG. 10 and a quantity of slurry 44 is admitted to the isolator 92 from connector 100 to a desired level; suction is then applied through hose 86 and the inner core 46 is accreted. As the level of slurry 44 in the said isolator falls, water is supplied through connector 98 to maintain submergence of the incomplete accretion. On completion of the said inner core, the elevator rod 22 is caused to descend and carry with it the attached base 82 and die 14 to the position shown in FIG. 11, whereon the remainder of accretion is substantially deposited and it may most conveniently be completed while the said die and base are returned to the position of FIG. 9. An "O" ring gasket 12 is shown as affording a seal between base 82 and isolator 92; however, the use of such a gasket may be avoided if the parts are made a good sliding fit and if the slurry 44 or the compensating water maintain a head over slurry 12 (as shown in FIG. 2) to prevent inopportune ingress of the latter slurry to the isolator. It should be realized that this structure, like those preceding, may be used to make items having more than two components if additional materials are furnished to the isolator and that, regardless of the number of components, the accretion need not be exposed to the air prior to completion.

The foregoing description of apparatus and modes of operation show that the invention may be used to make multilayer accretions without allowing the part in process to be exposed to the air prior to completion. It may be also readily deduced

that the operations are repeatable to add as many layers as are required and that the number of different slurries used is limited only by their access to the isolator; also, by removal of the isolator, the remaining apparatus is available to serve in the manner described by the above mentioned Anderson patents. It may also be here mentioned that while in many cases the isolator sleeve can be made big enough to hold sufficient slurry for the complete deposition of a layer of material, there is nothing to prevent the slurry, introduced via a hose, from being run as long as desired.

Each of the foregoing explanations of use has started with the accretion of an isolator sleeve containing slurry. However, there is no reason why the order of events should not be changed and a deposit from the large bath (slurry **12**) be made first and the die enclosed by the isolator afterwards. The apparatus is not sensitive to sequence. When the size of the isolator serves to determine the quantity of slurry available for a single component, it is desirable to have automatic level controllers, which are commonplace in the art of fluid handling; we have accordingly indicated the possible employment of such devices by schematically indicating control probes under reference number **104**.

It will thus be observed that the various objectives and advantages, enumerated at the beginning of this disclosure have been met, and that the present invention is easily adaptable to a number of modifications, variants and specific structural forms. It is therefore intended that the scope of this invention be limited only by the claims appended hereto.

What is claimed is:

1. The method of forming a multilayer accretion onto a die without permitting exposure to the air of said accretion during its formative stages comprising at least partially immersing a sleeve having a cavity into a first slurry of accretable material, placing a die within said cavity whereby said die is isolated from said first slurry of accretable material contacting said die with a second slurry of accretable material flowed into said cavity, applying a vacuum through the interior of said die and accreting a first deposit of said material onto said die, causing relative movement of said die and said sleeve whereby the isolating function thereof is terminated and said first slurry has access to first deposit, accreting a quantity of said first slurry onto said first deposit on the die to form a multilayer accretion removing said die from said first slurry to afford access to the multilayer accretion thereon.

2. The method of forming a multilayer accretion on a die without permitting exposure of said accretion to air which comprises immersing said die into a first liquid slurry containing accretable material, applying a vacuum through the interior of said die and causing deposit of said material on said die, surrounding said die with a movable sleeve having a cavity and isolating said die from said first slurry in the cavity of said movable sleeve, while simultaneously supplying a quantity of a second liquid slurry containing accretable material to said cavity while continuing application of the vacuum through said die and accreting a desired quantity of said second material onto said previously deposited accretion removing said die from said cavity and said first liquid slurry to provide access to the produced multilayer accretion.

3. In the process of accreting particulate material onto a die from a first slurry thereof contained in a tank into which said die is immersed, said die having a vacuum applied therethrough during such accretion, the improvement comprising providing in said tank a second slurry of accretable material and a movable sleeve surrounding said die and movable with respect to said tank and said die, said second slurry being contained in said sleeve wherein said die may be surrounded and isolated from said first mentioned slurry while a quantity of said second slurry is being accreted onto said die whereby the resultant product of such accretion comprises a multilayer deposit of both said first and second materials.

4. The invention according to claim **3** characterized by said die being continuously immersed in liquid from the commencement of accretion to the completion thereof in any one complete operating cycle.

5. In the process of accreting onto a movable die member having a foraminous area an article comprising deposits from a plurality of slurries furnished at least in part serially to said area, the improvement whereby one of said slurries is contained in a tank and another of said slurries is contained in a movable sleeve member immersible at least in part in said one slurry and whereby said die and sleeve members are relatively movable, the movement of one of said members relative to the other causing said area to be alternately exposed to and isolated from said one slurry and in the reverse sequence to the other of said slurries.

6. Apparatus for accreting onto a die having a foraminous area an article deposited from a plurality of slurries comprising a tank containing a first slurry means for moving a die within said tank so as to be immersed within said first slurry, sleeve means for isolating said die from said first slurry while immersed therein, means connected to said sleeve means for moving said sleeve means into and out of said tank, means for supplying a second slurry to the area between the isolated die and the sleeve means, and means connected to said die for applying a vacuum therethrough and causing deposit of accretable material on said die.

7. The apparatus according to claim **6** wherein said sleeve is secured to said tank and is partly above and partly immersed in said slurry, and wherein the means for moving said die into and out of said tank moves said die in a vertical direction.

* * * * *