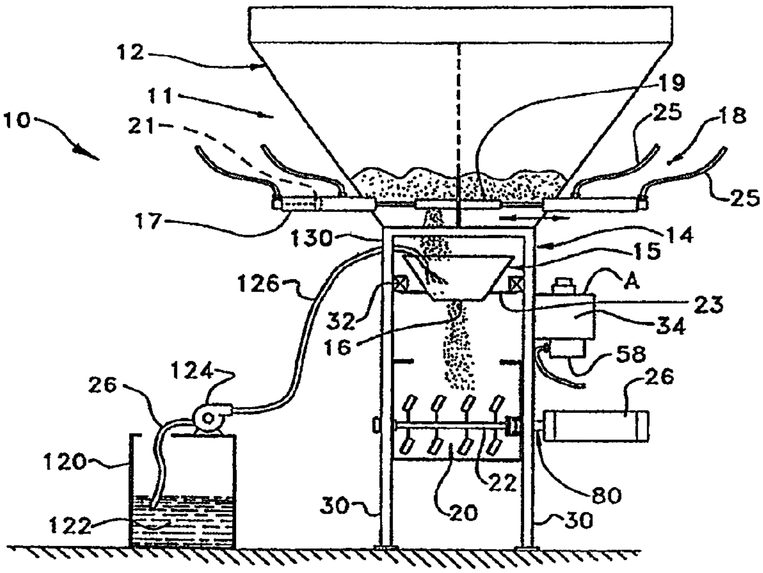
OPIC
OFFICE DE LA PROPRIÉTÉ INTELLECTUELLE DU CANADA

CIPO
CANADIAN INTELLECTUAL PROPERTY OFFICE

(12) (19) (CA) **Demande-Application**

(21) (A1) **2,240,049**
(86) 1996/12/10
(87) 1997/06/19

(72) MACGUIRE, Stephen B., US
(71) MAGUIRE PRODUCTS, INC., US
(51) Int.Cl.^{6} B29B 7/60, B01F 15/04
(30) 1995/12/11 (60/008,498) US
(30) 1996/04/23 (60/016,064) US
(54) **MELANGEUR GRAVIMETRIQUE**
(54) **GRAVIMETRIC BLENDER**



(57) L'invention concerne un mélangeur gravimétrique. Ce mélangeur comprend un châssis, un plateau de pesage, un dispositif connecté au châssis pour détecter le poids du plateau et tout matériau contenu dans ce dernier, et une chambre de mélange au-dessous du plateau, reliée au châssis. En outre, un piston est prévu pour permet tre la décharge dans la chambre de mélange, de manière sélective, du matériau placé dans le plateau. Par ailleurs, un élément d'élastomère relie le moyen formant détecteur au châssis et amortit les vibrations et le mouvement de choc lors du transfert du matériau.

(57) A gravimetric blender including a frame, a weigh bin, a device connected to the frame for sensing weight of the bin and any material contained therein, a mix chamber below the bin, connected to the frame, a piston for selectably releasing material in the bin downwardly into the mix chamber and an elastomer connecting the sensing means to the frame and damping transfer of vibration and shock motion therebetween.

CA 02240049 1998-06-09

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 **:**
B29C 31/06, B29B 7/60, B01F 15/02, 15/04 | **A1**

(11) International Publication Number: **WO 97/21528**

(43) International Publication Date: 19 June 1997 (19.06.97)

(21) International Application Number: PCT/US96/19485

(22) International Filing Date: 10 December 1996 (10.12.96)

(30) Priority Data:
60/008,498 11 December 1995 (11.12.95) US
60/016,064 23 April 1996 (23.04.96) US

(71) Applicant: MAGUIRE PRODUCTS, INC. [US/US]; 400 W. Knowlton Road, Media, PA 19063 (US).

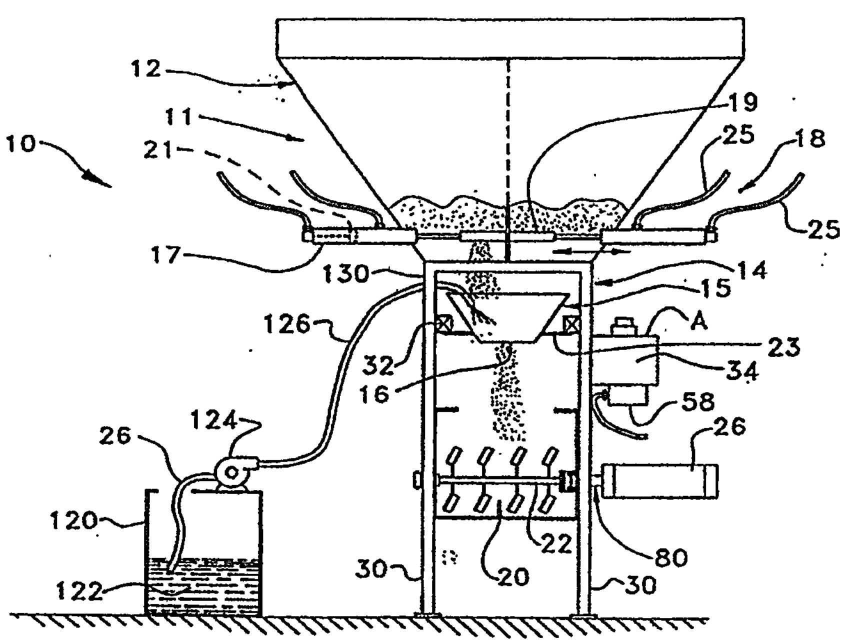
(72) Inventor: MAGUIRE, Stephen, B.; 1549 E. Street Road, Glen Mills, PA 19432 (US).

(74) Agent: QUINN, Charles, N.; Dann, Dorfman, Herrell & Skillman, Suite 720, 1601 Market Street, Philadelphia, PA 19103-2307 (US).

(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: GRAVIMETRIC BLENDER



(57) Abstract

A gravimetric blender including a frame, a weigh bin, a device connected to the frame for sensing weight of the bin and any material contained therein, a mix chamber below the bin, connected to the frame, a piston for selectably releasing material in the bin downwardly into the mix chamber and an elastomer connecting the sensing means to the frame and damping transfer of vibration and shock motion therebetween.

GRAVIMETRIC BLENDER

Background of the Invention

This invention relates generally to methods and apparatus for providing precisely measured amounts of granular materials and, optionally, precisely measured amounts of coloring agent(s), particularly pigment in liquid form, preparatory to further processing of the combined granular materials and, optionally, liquid coloring agent(s), and specifically to gravimetric blenders, optionally in combination with color addition pumps, providing precisely measured amounts of plastic resin material, and, optionally liquid coloring agents, and mixing these components prior to supplying the blended mixture to plastics manufacturing and processing equipment such as plastic injection molding, compression molding and extrusion equipment.

Field of the Invention and Description of the Prior Art

Gravimetric blenders operate by blending solid plastic resin material components and additives, by weight, in batches. Typically batches of material may consist of several solid material components. One of these may be "regrind", consisting of ground plastic resin which had previously been molded or extruded and which either resulted in a defective product or was excess material not formed into a desired product.

Another component may be "natural" plastic resin which is virgin in nature in the sense that it has not previously been processed into a molded or extruded plastic part.

Yet another component may be a solid color material, typically flakes or freeze dried material, used to produce a desired color of the finished plastic part.

Still yet another component may be an additive used to adjust the blend to provide required performance characteristics during molding, extrusion or subsequent processing.

The gravimetric blender as originated by the applicant and as copied widely throughout the world typically includes hoppers for each of the components of the solid material to be blended together. Typically several hoppers or several compartments in a hopper may be provided, such as one compartment for "regrind" material, one compartment for "natural" material, one component for solid color additive material and one compartment for "additive". When the gravimetric blender operates, the unit desirably operates automatically, adding each of the component solid materials in the proper, desired percentages. Each solid material component is dispensed by weight into a single weigh bin. Once the proper amounts of each component have been serially dispensed into the weigh bin, all of the components are dropped together into a mixing chamber from the weigh bin.

As one of the components forming a part of the resulting blend it is known to supply solid color additives to the blend in order to provide a blend of a desired color. These color additives may be flaked pigments on wax carriers or in freeze dried form. It is also known to provide the color as pigment powder constituting one component of the resulting blend.

Liquid color material cannot be preblended into one of the solid material components and stored because of the danger inherent and difficulties attendant to clean-up in the event of component failure. Hence, liquid color, when used in plastics material processing heretofore, has been metered directly into the throat of a molding press or an extrusion machine, at a position to join the solid resinous material blend just prior to the molding or extrusion operation. This approach creates difficulties, among them being compensating for addition of pre-colored regrind solid material to the material mix.

When regrind is added to the blend of plastic resin materials, the regrind already contains the necessary color; such regrind need not be colored a second time. When metering resinous material at the throat of a molding press or an extrusion machine, such metering is conventionally performed volumetrically. Hence, the presence of already colored regrind, not requiring additional coloration, cannot be detected. As a result, excess liquid color is typically added to the blend, sometimes producing an unacceptable product and always resulting in the use of unneeded color material, which is undesirable and results in unnecessary expense.

Gravimetric blenders typically use one or more load cells to detect the weight of the weigh bin and material contained therein. Vibrational and shock loading of the load cells may result in erroneous measurements of the weight of the weigh bin and the material contained therein. These erroneous measurements may result in addition of excess material or an insufficient amount of a material component in a subsequent batch thereby producing a batch of blended material deviating from the desired specifications.

Because the frame of the gravimetric blender must be a rigid, high strength structure to provide the required strength to support the material storage hoppers and other components of the gravimetric blender, the gravimetric blender frame is typically steel. Since the frame is steel and rigid, shock and vibrational loads applied to the frame are readily transmitted along the frame and received by the various components of the gravimetric blender connected to the gravimetric blender frame.

When the gravimetric blender is mounted directly on a plastics material processing machine such as an extruder or, more particularly, an injection molding machine, the load cells of the gravimetric blender can be subjected to very substantial shock and vibrational loading. Injection molding machines have heavy steel platens and molds which open and close as parts are molded and ejected. There is a considerable amount of movement in an injection molding machine and the parts which move are heavy. Hence shock loads, which continuously propagate throughout injection molding machines and hence propagate through the gravimetric blender when the blender frame is bolted to the injection molding machine, maybe quite substantial.

In gravimetric blenders utilizing single load cells, loads the single cell may be substantial. In single load cell gravimetric blenders the single load cell has the weight of the weigh bin cantilevered on an arm and the cell bears the entire weight of the weigh bin and the material contained therein. Hence vibrational loading of the frame of the gravimetric blender may produce substantial vibrational loading of the load cell with stress to the load cell due to the weight carried by the load cell. The cantilevering of the weigh bin from the load cell results in high moments of inertia being applied to the load cell when the load cell is subject to vibration and shock loading.

Summary of the Invention

This invention provides a gravimetric blender/color addition pump combination where the gravimetric blender includes a frame, a hopper supported on the frame, a weigh bin below the hopper and load sensing means mounted on the frame for sensing weight of the bin including material contained within the bin.

The gravimetric blender further preferably includes preferably pneumatic piston-actuated means, preferably connected with the hopper, for releasing material within the hopper towards the weigh bin. A mix chamber preferably below the bin preferably includes mixing means therewithin.

The gravimetric blender preferably further includes pneumatically actuated means for releasing material within the bin into the mix chamber. A motor preferably rotates the mixing means.

Respecting the combination of the gravimetric blender and the color addition pump means for supplying liquid color to the material mix for blending therewith, the pump means supplying liquid color may desirably be a peristaltic pump or a progressive cavity pump. The liquid color is supplied by such a liquid pump in an amount measured by weight in the blender, in the same manner as the other, solid material components of the resulting material blend are added. Peristaltic pumps are preferred.

In another of its aspects this invention embraces a method for preparing plastic resin material for manufacturing processing such as molding or extrusion. The method includes serially metering respective solid resinous materials to the weigh station until pre-selected weights of the respective materials are at the weigh station. The method further includes metering liquid color to the weigh station to join at least one of the materials which have been metered to the station until a pre-selected weight of liquid color is at the weigh station. The method further includes providing the serially metered solid materials and the pre-selected weight of liquid color material unitarily to a mixing station. The method further embraces mixing the unitarily supplied serially metered solid granular materials and a pre-selected weight of liquid color into a blend preparatory to manufacturing processing via molding or extrusion.

In another of its aspects the invention may provide spring-loaded solenoid valve means for actuating the means for releasing material within the hopper, preferably by applying pneumatic pressure to a piston associated with the hopper material releasing means, including means for enclosing the solenoid valve means thereby preventing finger actuation of the solenoid valve means. The gravimetric blender may yet further include manually controlled means, adapted for passage through the enclosure means, for overriding the solenoid valve means to result in application of pneumatic pressure to the piston of the hopper material releasing means thereby releasing any material within the hopper and permitting gravity induced flow thereof.

In another of its aspects, the gravimetric blender includes axially self-aligning means for coupling the motor to the mixing means.

In another of aspects this invention provides a gravimetric blender having a frame, a weigh bin, means connected to the frame for sensing weight of the bin and any material contained therein, a mix chamber below the bin and connected to the frame with mixing means within the mix chamber, means for selectably releasing material in the weigh bin downwardly into the mix chamber with means connecting the weight sensing means to the frame and damping transfer of vibration and shock motion therebetween. The connecting means damping transfer of vibration and shock motion between the frame and the sensing means is elastomeric and is most preferably rubber.

In a yet further aspect of the invention the connecting means which damps transfer of vibration and shock motion between the weight sensing means and the frame includes an elastomeric member interposed between the frame and the weight sensing means. This elastomeric member is preferably annularly disposed about a shaft mutually received by the frame and the mounting portion of the weight sensing means.

Brief Description of the Drawings

Figure 1 is a side elevation of a gravimetric blender with a liquid color pump.

Figure 2 is a side sectional view of apparatus enclosing solenoid valve means and preventing finger actuation thereof which may be provided as a portion of the gravimetric blender illustrated in Figure 1.

Figure 3 is a view of the apparatus illustrated in Figure 2 taken looking from the right side in Figure 2.

Figure 4 is a front view of part of a male member portion of axially self-aligning means for coupling a motor to a mixer in the gravimetric blender illustrated in Figure 1.

Figure 5 is a side view of the part of the male member of the coupling means illustrated in Figure 4 with certain of the hidden lines, which would otherwise be present, removed for drawing clarity.

Figure 6 is a view analogous to that of Figure 4, illustrating a female portion of the coupling means in a front view.

Figure 7 is a side view of the female portion illustrated in Figure 6.

Figure 8 is a front view of a plug portion of the male member of the coupling means.

Figure 9 is a side view of the plug portion illustrated in Figure 8.

Figure 10 is a side view of a pin adapted to fit in and extend from the female portion of the coupling means illustrated generally in Figures 6 and 7.

Figure 11 is a side schematic view of axially self-aligning means for coupling a motor to a mixer in the gravimetric blender illustrated in Figure 1, showing the component parts illustrated in Figures 4 through 10 assembled and ready for coupling of the male and female members together.

Figure 12 is a side view of a load cell and associated structure connecting a weigh bin to a frame of a gravimetric blender including means for shock and vibration isolating the load cell from the frame, where the gravimetric blender employs a single load cell.

Figure 13 is a side view of a load cell and associated structure connecting a weigh bin to a frame of a gravimetric blender including means for shock and vibration isolating the load cell from the frame, where the gravimetric blender employs two load cells.

Figure 14 is an enlarged view of the structure illustrated in Figure 12 as indicated by circle AA in Figure 12.

Figure 15 is an enlarged view of the structure illustrated in Figures 12 and 14 taken at circle CC in Figure 14.

Figure 16 is an enlarged broken side view of a load cell and associated structure, similar to Figure 14, connecting a weigh bin to a frame of a gravimetric blender including means for shock and vibration isolating the load cell from the frame in accordance with a preferred embodiment of the invention for single load cell blenders.

Figure 17 is an enlarged broken side view of a load cell and associated structure, similar to Figure 14, connecting a weigh bin to a frame of a gravimetric blender including means for shock and vibration isolating the load cell from the frame in accordance with a second preferred embodiment of the invention for single load cell blenders.

Figure 18 is an enlarged view of the structure illustrated in Figure 13 as indicated by circle BB in Figure 13.

Figure 19 is a side elevation of the load cell and associated structure illustrated in Figure 18, looking from the right side in Figure 18.

Detailed Description of the Invention

Referring to the drawings and to Figure 1 in particular, a gravimetric blender together with a color addition pump are illustrated with this combination being indicated generally 10.

The gravimetric blender is designated generally 11 and includes a hopper, designated generally 12, supported by a frame designated generally 14 which holds a weigh bin 15 into which portions of plastic resin material, and optionally liquid color material, can be metered and weighed prior to release into a mix chamber as described below. Frame 14 preferably includes four upstanding members, which are preferably steel angle iron and are identified 30 with two of upstanding members 30 being illustrated in Figure 1. Frame 14 preferably further includes webs connecting upstanding members 30 together to provide rigidity for frame 14. These webs have not been illustrated in the drawings.

Hopper 12 preferably has multiple internal compartments so that a plurality of different solid resinous materials may be dispensed from hopper 12 into weigh bin 15 by suitable slide gates, designated generally 19, located at the bottom of a given compartment of hopper 12.

Gravimetric blender 11 may further include pneumatically actuated piston means 21, housed within cylinders 17, which are connected with hopper 12 via slide gates 19. Piston means 21 operate in response to signals to move slide gates 19 thereby to release material stored within hopper 12 downwardly towards weigh bin 15. The pneumatic piston-cylinder actuated slide gate combinations are designated generally 18 in Figure 1.

Alternatively, one or more auger feeders may be used in lieu of a portion of hopper 12. Auger feeders are desirably used for components which are added at 5% or less to the mix blend; however, auger feeders add to the cycle time for each batch and reduce overall throughput rates. Hence, auger feeders are desirably optionally used only for addition of low percentage components to the blend to be mixed.

Positioned within and preferably slidably retained in place by frame 14 below weigh bin 15 is a mix chamber 20 having a mixing means which is preferably in the form of a mixing agitator 22 rotatably disposed therewithin. Agitator 22 is mounted for rotation about an axis 24 preferably shared with a drive motor

26. Motor 26 preferably has its drive shaft positioned to drive mixing agitator 22 about a common axis. Drive motor 26 is preferably supported by a cantilevered support, which has not been illustrated in the drawing for clarity, extending laterally from an upstanding member 30 of frame 14.

While the gravimetric blender illustrated in Figure 1 has been depicted showing a single rotatable mixing means 22, two mixers, one desirably located above the other, may also be used for high volume applications. Mix chamber 20 may be fabricated to be slidably removable from frame 14 with mix chamber 20 being movable in a direction parallel with the axis of agitator 22.

Desirably located proximate to gravimetric blender 11 as illustrated in Figure 1 is an optional liquid color reservoir 120 having liquid color therein denoted 122. A pump 124 is desirably a peristaltic pump or perhaps a progressive pump or a piston pump and connects to liquid color reservoir 120 to draw liquid color 122 from reservoir 120 by a pump color feed line 126. Pump 124 preferably provides liquid color to gravimetric blender 11 via mixer color feed line 128. This line connects to frame 14 of gravimetric blender 11 via tube holding fitment 130 through which liquid color material 122 is introduced to the upper portion of weigh bin 15 of gravimetric blender 11.

Pump 124 is desirably mounted at least close to, and preferably on, optional liquid color reservoir 120, as illustrated in Figure 1. Such location and mounting of pump 124 close to and desirably on top of reservoir 120 is necessitated by the nature of the liquid color 122 in reservoir 120.

Specifically, liquid color 122 is typically extremely thick and viscous. Liquid color material 122 can be pumped using positive pressure a much longer distance than the liquid color material 122 can be drawn by suction or vacuum. Pumping using pump 124 may produce pressures of up to 100 pounds per square inch. Suitable pumps for use as liquid color pump 124 are available from Maguire Products, Inc. in Media, Pennsylvania.

Weight of material in weigh bin 15 is preferably sensed by load cells 32 which are preferably connected to microprocessor control means 34 which regulates operation of the gravimetric blender 11 through electrical connection with the load cells, the solenoid actuators for the solenoid valves, the motor, the liquid color pump and the like.

The microprocessor provides control of gravimetric blender 11 by monitoring, preferably on a continuous basis, weight of material, if any, at a weighing station defined by weigh bin 15. By sensing weight of weigh bin 15 and opening appropriate slide gates 19, microprocessor control means 34 serially meters respective components of solid granular resinous material to the weighing station defined by weigh bin 15 until a pre-selected weight of each of the respective components has arrived at the weigh station.

Microprocessor 34, through monitoring weight of the weigh bin and material therewith, optionally controls metering liquid color to the weighing station defined by weigh bin 15 and adds the metered liquid color to the respective components of solid granular material at the weigh station until a pre-selected weight of liquid color has arrived at the weigh station and has been added to the batch of solid material defined by the collective components in weigh bin 15.

Blender 11 preferably operates by blending components by weight based on settings which are preferably shown on a master controller portion of microprocessor controller 34. Blending is desirably done in batches of 2,000, 4,000, 9,000 or 18,000 grams, depending on the amount desired. Each component is preferably dispensed separately into weigh bin 15 and then all components are dropped together into mixing chamber 20.

Blender 11 is designed to mount directly over the feed throat of a process machine used to mold or extrude plastic material with blender 11 being bolted or otherwise fixedly connected to the process machine.

When exclusively solid materials are being blended, typically regrind material is dispensed first according to the percent of regrind material required. If no regrind material or a limited amount of regrind material is present, then portions of natural material, solid color material and additive material are increased to bring about a full batch weight. Natural material is typically added second. The amount of natural material added is preferably calculated by microprocessor 34 to leave exactly the right amount of room in the mix chamber for the solid color material and additive material. Once the natural material fill portion of the cycle has been completed, the exact weight of the natural material that has been actually dispensed is determined to detect any errors. Based on this actual weight of natural material dispense, color additive in the form of solid color additive material is metered into the weigh bin and then other solid additive materials are metered into the weigh bin in the same manner. All components are then dumped into the mixing chamber which is preferably continuously running.

In the case where liquid color material is used in place of solid color material, the liquid color material is preferably added to the weigh bin last.

Microprocessor control means 34 provides the serially metered components and the optional preselected weight of liquid color material unitarily to a mixing station defined by mix chamber 20 by opening weigh bin 15 thereby to permit the materials vertically supported thereby to fall downwardly into the mix chamber. Weigh bin 15 is preferably opened by a pneumatic piston-cylinder combination, which is controlled by microprocessor 34 and has not been illustrated in the drawings for drawing clarity. The pneumatic piston-cylinder combination is mounted on frame 14 and is connected to weigh bin 15 so that weigh bin 15 opens responsively to movement of the piston member of the piston-cylinder combination.

In mix chamber 20 the solid material components which have been preferably unitarily supplied and serially metered to weigh bin 15, and optionally a pre-selected weight of liquid color material, are mixed into a blend preparatory to being supplied to the manufacturing processing machine such as a molding press or an extrusion machine.

When the optional liquid color is introduced to the material to be blended in weigh bin 15 and has been dropped into mix chamber 20, the mixer portion, specifically mixing agitator 22 of gravimetric blender 11, effectively precoats the material pellets, which have come from hopper 12 through weigh bin 15 into mix chamber 20, with the liquid color. This produces superior color dispersion in final production parts produced by injection or compression molding or by extrusion, providing a substantial improvement over results achieved when liquid color material is blended with plastic resin by metering liquid color directly into the throats of plastic material processing machines such as extruders and molding presses. Supplying liquid color 122 to weigh bin 15 of gravimetric blender 11 using pump 124 permits accurate computerized tracking of liquid color material used.

Liquid color 122 by its very nature presents a continuous potential for substantial clean-up difficulties in the event of a spill, malfunction of equipment or breakage of any of the feed lines such as pump color feed line 126 or mixer color feed line 128. Providing liquid color 122 directly into weigh bin 15 of gravimetric blender 11 provides a practical means of handling liquid color 122 and minimizes clean-up problems in the event of equipment failure.

Desirably, monitoring of weight of material at the weighing station is performed continuously by the microprocessor continuously digitally sensing signals supplied by load cells which are depicted schematically in Figure 1 and identified generally 32 therein; the load cells are interposed between weigh bin 15 and frame 14. Weigh bin 15 is suspended by and from load cells 32 with respect to frame 14. Depending on the size of weigh bin 15, a single load cell or multiple load cells may be used. Most desirably metering of liquid color to the weighing station defined by weigh bin 15 is performed peristaltically.

Microprocessor control means 34 actuates solenoid controlled preferably pneumatic valves, which are not illustrated in Figure 1 but which are shown schematically as 36 in Figures 2 and 3, to provide pneumatic pressure via suitable conduits to piston-cylinder slide gate combinations 18. Solenoid valves 36 actuated by control means 34 are each individually connected via two suitable conduits, which are preferably flexible plastic tubing, to associated individual piston-cylinder slide gate combinations 18 to open and close individual slide gates 19 by application of pneumatic pressure to an appropriate side of a piston 21 portion of a piston-cylinder combination 17.

Each solenoid valve 36, specifically the core of the solenoid, is spring-biased towards a position corresponding to that at which the piston member 21 of a piston-cylinder slide gate combination 18 associated with a given solenoid valve 36 is at a preferred position, referred to as the default position, for operation of gravimetric blender 11. When due to a change in operational factors such as removal of a blended batch from mix chamber 20, need for additional material in weigh bin 32, commencement of a loading cycle or the like, microprocessor control means 34 senses that it is required to actuate a given piston of a piston-cylinder slide gate combination 18. One example might be to open one of the compartments within hopper 12 to add an amount of component material in that compartment to weigh bin 15. In such case microprocessor control means 34 actuates the solenoid valve associated with the given piston-cylinder slide gate combination of interest thereby moving the piston member of the appropriate piston-cylinder slide gate combination 18 from the default position to a position at which a given hopper slide gate is open or other desired action has been taken.

Referring to Figure 2, each solenoid valve, one of which has been designated generally 36, includes a valve member 38 and a solenoid actuator 40, both of which have been shown in schematic form in Figure 2. Suitable wiring, which has been designated 42 in Figure 2, leads from solenoid actuator 40 to microprocessor control means 34, which has not been illustrated in Figure 2.

Each solenoid actuator 40 includes a core member, not illustrated in Figure 2, which when actuated due to voltage being applied to an associated coil, moves axially respecting the coil and actuates associated valve member 38 against the bias of a spring, also not illustrated in Figure 2, which continuously urges the core towards the default position.

The solenoid actuated valves function to move pistons within air cylinders by pressurizing one side of a piston and opening the other side to the atmosphere. There is no vacuum involved, just pressure above atmospheric pressure and ambient atmospheric pressure.

Valves 36 are preferably four-way solenoid valves, meaning that each valve has four ports. These are a pressure port, an exhaust port and two function ports which are connected to the given air cylinder of interest by the flexible plastic tubing. The pressure and exhaust ports are connected to air pressure and ambient atmosphere respectively by way of a manifold 44 which is drilled to provide common pressure and exhaust ports for all of the solenoid actuated valves.

The valve in its normally at rest or default state connects pressurized air to an "A" port and ambient air to a "B" port. When the valve is energized the A port is switched to ambient air and the B port is switched to the pressurized air. Two air lines 25 preferably connect each solenoid actuated valve to a given air cylinder with one solenoid actuated valve being provided for and connected to each air cylinder. At rest or default, a piston 21 within a given air cylinder 17 is preferably extended so that the slide gate actuated by piston 21 is closed. When the associated valve 36 is energized, piston 21 retracts, the associated slide gate 19 opens and material in the hopper is dispensed downwardly.

Solenoid actuated valves 36 may also be used to operate the weigh bin dump and further may be used to operate an optionally flow control valve serving the shutoff and exit opening at the bottom of the blender. If the blender is fitted with such a flow control at the bottom, the flow control valve may hold material in the chamber for a time period for better mixing.

Each solenoid valve 36 preferably has associated therewith a pair of pneumatic conduits, each of which is connected to manifold 44 as illustrated in Figure 2. One of the pneumatic conduits preferably leads to a pressurized air inlet portion of manifold 44 where the air inlet or a pressurized portion of manifold 44 has been designated 50 and is illustrated as a conduit extending longitudinally through manifold 44. Similarly, a second one of pneumatic conduits associated with a given solenoid valve 36 is an unpressurized, ambient air conduit and communicates with an exhaust portion of manifold 44 where the exhaust portion has been designated 52 in Figure 2 and has similarly been illustrated as a conduit extending longitudinally through manifold 44.

Valve 38 operates to connect either positive air pressure, as received by pneumatic conduit 55 communicating with pressurized air inlet 50 or ambient pressure as present in pneumatic conduit 53 communicating with the exhaust or ambient portion 52 of manifold 44 to default and signal conduits 51, 57 respectively as illustrated in Figure 2. Apertures formed in manifold 44 define open ends of the respective pressurized and ambient conduits 51', 57' which communicate with corresponding pressurized and ambient conduits 51', 57' of valve 36 with apertures 56', 56' defining outlets of conduits 51', 57' from manifold 44 as shown in Figure 3. One of apertures 56', 56'; has been illustrated with a fitting 54 in Figure 2. Use of the prime notation in this paragraph serves to distinguish portions of conduits 51', 53', 55' and 57' formed in manifold 44 from the portions of those corresponding conduits forming a part of a respective solenoid valve 36.

Solenoid valves 36 and especially solenoid actuators 40 of valves 36 are preferably maintained within an enclosed housing designated generally 58 in Figure 2. Housing 58 is preferably of sheet metal construction and, as illustrated in Figure 2, can be constructed from multiple pieces secured together by nut and bolt combinations, by sheet metal screws or by other means. Closed housing 58 preferably fits around solenoid actuators 40 and specifically preferably encloses face surfaces 60 of solenoid actuators 40 in which or from which the movable core of the solenoid portion of solenoid valve 36 may be accessed. In Figure 2, the solenoid core and specifically the tip portion thereof of valve 36 has been illustrated schematically as 62.

Retained within closed housing 58 is a block 64 which includes bores 66 therein. Block 64 is fabricated of a size and positioned within housing 58 so as to have a planar surface 68 which is in close proximity and preferably in facing complemental contact with all of faces 60 of solenoid actuators 40 via which the core members 62 of given solenoid valves 36 may be accessed.

Block 64 is retained rigidly and fixedly within closed housing 58 and positioned with bore 66 communicating with tip 62 of the movable solenoid core. Due to the close placement of face 68 in preferably essentially complemental, and in any event close proximity to, and parallel disposition with face 60, block 64 makes tip 62 of the solenoid core effectively inaccessible by an operator's fingers. Block 64 is preferably constructed of sufficient size to adequately overlap the area or aperture, as illustrated in Figure 2, within which or via which tip 62 of a movable solenoid core may be accessed. Block 64 is preferably fabricated from a solid piece of aluminum or other metal or of plastic.

Push rods 70 may be provided within bore 66 for manual actuation of solenoid core tips 62 by manually pushing on a remote end of A rod 70, denoted 72 in Figure 2.

In jurisdictions where safety regulations prohibit manual actuation of solenoid valves, manual override of pneumatically actuated solenoid valves 36, rods 70 would not be present. In such case, due to the presence of block 64 override of solenoid valves 36 could only be accomplished using a suitable secured tool, thereby preventing direct manual actuation and override of a solenoid valve 36.

Preferably manifold 44, solenoid valves 36, closed housing 58 and the associated structure are mounted on the bottom side of a housing for microprocessor 34, which is provided in cantilevered fashion extending from upstanding members 30 of frame 14, as illustrated in Figure 2. Manifold 44, associated solenoid valves 36, closed housing 58 and the structure enclosed therewithin may be secured to the bottom of the housing for microprocessor 34 which has been designated 74 in Figure 2 via suitable bolt and nut combinations 76, as illustrated in Figures 2 and 3.

Referring to Figures 4 and 5, the axially self-aligning means, designated generally 80 in Figure 1, for coupling drive motor 26 to mixing agitator 22 preferably includes male and female portions where the component parts of the female portion are illustrated in Figures 6, 7 and 10 and the component parts of the male portion are illustrated in Figures 4, 5, 8 and 9.

Axially self-aligning means 80 for coupling motor 26 to mixing means 22 preferably has a female portion which is preferably generally cylindrical in shape and has been designated generally 78 in Figures 6 and 7. The coupling apparatus itself is designated generally 80, and is illustrated in schematic form in Figure 1.

Female member 78 preferably has an axially facing central bore 82 formed therein as illustrated in Figure 7. Bore 82 preferably includes an axially tapered annular wall 84 which communicates with an end 86 of preferably cylindrical female member 78. End 86 is preferably in the form of a planar, preferably annular surface and is adapted for mating connection with a male member 88, illustrated in Figures 4 and 5, of axially self-aligning coupling means 80. The manner in which female member 78 matingly connects with male member 88 to assure axial alignment of coupling means 80 is illustrated in Figure 11.

Female member 78 further includes a cylindrical wall 90 forming a portion of axially facing central bore 82. Wall 90 adjoins axially tapered annular wall 84 at one extremity thereof and adjoins an annular bottom 92 of central bore 82 at a second axial extremity. Axially facing central bore 82 extends entirely through female member 78 as a portion of reduced diameter indicated as 94 in Figure 7; the reduced diameter portion 94 of axially facing central bore 82 has not been illustrated in Figure

11 to facilitate drawing clarity and understanding of the operation of axially self-aligning coupling means 80.

Female member 82 may be retained in place on the shaft of drive motor 26 or on the shaft of mixing agitator 22 by keying the selected shaft together with a set screw, for which mating threads and a suitable receiving bore have been illustrated in Figure 6. The keyed arrangement in the reduced diameter portion 94 of bore 82 of female member 78 is illustrated in Figure 6. The keyway, which has not been numbered, has been illustrated in dotted lines in Figure 7. The set screw and threaded bore for the set screw, illustrated generally in Figure 6, have been omitted from Figure 7, and from Figure 11, to aid drawing clarity.

Female member 78 further preferably includes a pair of closed bottom bores 98, 98', which are preferably disposed diametrically opposite from one another and formed in facing surface 86 of female member 84 at a position outboard of the outer extremity of axially tapered annular wall 84 in such surface. Closed bottom bores 98 are provided to house spring-loaded pins 100, one of which has been illustrated in Figure 10. Pins 100 are preferably spring-loaded against the bottom of closed bottom bores 98 to protrude from surface 86 towards male member 88. Pins 100 are biased outwardly from bottoms of closed bottom bores 98 by springs 114 which are preferably fitted within and extend from pins 100 as illustrated generally in Figures 10 and 11.

As illustrated in Figures 4, 5 and 11 male member 88 is generally cylindrical in form and has an annular plug 102 extending therefrom where the plug has been illustrated in Figures 8 and 9. Plug 102 is preferably manufactured from a thermoplastic material such as those sold under the trademarks Nylon, Delrin and Celcon. Plug 102 preferably includes a cylindrical portion 104 and an axially tapered portion 106. Cylindrical portion 104 is preferably sized for close complemental fitting with cylindrical wall 90 of axially facing central bore 82 in female member 78. Tapered portion 106 is preferably tapered at the same angle relative to the axis as axially tapered annular wall 84 of axially facing central bore 82 in cylindrical female member 78. Plug 102 is preferably held in place at the center of cylindrical male member 88 by suitable set screws, machine screws and the like which have not been illustrated in the drawings.

Cylindrical male member 88 further preferably includes a pair of diametrically opposed bores 108, 108' which are spaced away from the axis of male member and positioned to receive spring-loaded pins 100 protruding from closed bottom bores 98 of cylindrical female member 78 of coupling member 80. The receipt of spring-loaded pins 100 extending from female member 78 by diametrically opposed bores 108, 108' formed in male member 88 is depicted schematically by dotted lines P in Figure 11. When cylindrical female member, specifically surface 86 thereof, is sufficiently proximate to facing surface 110 of cylindrical male member 88 that retractable pins 100, protruding from closed bottom bores 98, engage bores 108 in cylindrical male member 88 as depicted by dotted lines P, tight coupling with essentially no rotational play between male and female members 88, 78 is effectuated.

As illustrated in Figure 11 the coupling member 80 of which principal components are illustrated in Figures 4 through 10 is axially self-aligning due to the configuration of plug 102, specifically the wall profile thereof which is initially tapered and thereafter cylindrical. When initial tapered portion 106 of plug 102 encounters the correspondingly tapered portion defined by axially tapered annular wall 84 in female portion 78, the taper between the two surfaces, specifically upon contact therebetween, causes male and female coupling members 78, 88 to axially align, thereby providing a self-aligning coupling which is effectuated as pins 100 protruding from closed bottom bores 98 find bores 108 in face 110 and extend thereinto. Engagement of pins 100 and bores 108 provides excellent torque transfer between male and female members 88, 78 constituting axially self-aligning torque coupling 80.

Spring loading of pins 100, as the male and female members of coupling assembly 80 approach one another and surfaces 86, 110 become proximate one another, permits those pins to retract slightly into closed bottom bores 98 as the extremities 112 of the pins protruding from bores 98 contact surface 110. Hence any destructive forces are ameliorated as pins 100, specifically outermost surfaces 112 thereof, contact surface 110 and run on surface 110 due to relative rotation between the male and female members until pins 100 find bores 108, 108' and extend thereinto, thereby effectuating tight connection between the male and female members of axially self-aligning coupling means 80.

Figure 12 illustrates a portion of a single load cell embodiment of the invention including means for connecting the load cell to frame 14 of gravimetric blender 11 for damping transfer of vibration and shock motion between frame member 30 and load cell 32. In the single load cell embodiment the means for connecting the load cell to the frame of the gravimetric blender includes structure for connecting the weigh bin 15 to the load cell 32 preferably in a manner that weigh bin 15A is effectively cantilevered from load cell 32.

Figure 13 illustrates a portion of a dual load cell gravimetric blender including means connecting the load cells to frame 14 of gravimetric blender 11 and damping transfer of vibration and shock motion therebetween. In the dual load cell embodiment weigh bin 15 is preferably supported by and preferably rests directly on a pair of brackets, which are generally of zig-zag shape and are designated generally 23 in Figure 13. Weigh bin 15 preferably rests directly on brackets 23 which transfer weight of weigh bin 15 and any material contained there into load cells 32.

As illustrated in Figure 14 which is an enlarged version of the structure illustrated in circle AA in Figure 12, load cell 32 is mounted on and contained within a load cell enclosure box designated generally 154.

Box 154 has a vertically upstanding portion 174 and upper and lower horizontally extending portions 176 and 178 respectively.

The weigh bin has been designated 15A in Figure 14, with the letter "A" denoting that the gravimetric blender has but a single load cell 32.

The gravimetric blender illustrated in Figure 1 has two load cells 32. Larger capacity gravimetric blenders are provided with two load cells whereas smaller capacity gravimetric blenders utilize only a single load cell, for economy purposes.

Referring still to Figure 14 there is connected to weigh bin 15A a weigh bin bracket 156A which is fixedly secured to weigh bin 15A. Weigh bin bracket 156A includes a vertically extending portion designated 180 in Figure 14, which is preferably fixed in facing complemental contact with weigh bin 15A.

A portion 182 of weigh bin bracket 156 extends horizontally outwardly from vertical portion 180 of the weigh bin bracket at the upper extremity thereof while a corresponding horizontally extending portion 184 extends laterally outwardly, in a horizontal direction, from the lower extremity of vertical portion 180 of the weigh bin bracket as illustrated in Figure 14. An upper outer extremity of weigh bin bracket 156 extends vertically downwardly from an outboard extremity of horizontally extending portion 182; this vertically downwardly extending portion of bracket 156 is designated 186 in Figure 14. A corresponding lower vertically upwardly extending portion of weigh bin bracket 156 is designated 188 in Figure 14 and extends vertically upwardly from the lateral outward extremity of horizontally extending portion 184 of weigh bin bracket 156.

Vertically extending extremities 186, 188 provide an open envelope structure which permits weigh bin 15A and particularly weigh bin bracket 156 to move slidably horizontally, in a direction perpendicular to the plane of the paper in Figure 14, to be positioned so that weigh bin 15A effectively hangs on and is cantilevered from load cell 32.

Affixed to load cell 32 for receiving the weight load and transferring the same to load cell 32 is a load transfer beam 170. Load transfer beam 170 has an upper horizontally extending portion 190 fixedly connected by screw 214 to the upper surface of load cell 32, a lower generally horizontally extending portion 192 and a central portion 194 extending between upper and lower portions 190, 192 and slightly canted from the vertical illustrated in Figure 14. Load cell 32 senses the weight load of weigh bin 15A and any material contained therein by strain resulting at the upper surface of load cell 32 where load transfer beam 170 is fixedly connected thereto. Load cell 32 is fixed to load cell enclosure box 154, particularly to lower horizontally extending portion 178 of load cell enclosure box 154 via suitable screws 222, only one of which is visible in Figure 14.

Affixed to central portion 194 of load transfer beam 170 is a load transfer plate designated 196 in Figure 14. Plate 196 is preferably slotted at the central portion thereof with the slot designated generally 198 in Figure 14. Slot 198 is relatively short, preferably being only about 1 inch in length, and is provided to receive a tab member 168 which extends laterally from vertical portion 180 of weigh bin bracket 156, as weigh bin 15A is slidably positioned on and supported by load transfer plate 196. When weigh bin 15A is fully in position and tab 168 has traversed the relatively short length of slot 198, tab 168 disengages from slot 198 and the weigh pan moves slightly downwardly, with the upper interior of weigh bin bracket 156 coming to rest on the vertical upper extremity of load transfer plate 196. In this position weigh bin 15A is effectively cantilevered with respect to load cell 32 and the load represented by the weight of the weigh bin 15A and any material contained therein is transferred directly to load cell 32 by load transfer plate 196 and load transfer beam 170, with load cell 32 effectively sensing the weight of material contained within bin 15A.

To protect load cell 32 from contact and possible damage by operators, load cell 32 is preferably within load cell enclosure box 154 as illustrated in Figure 14. Load cell enclosure box 154 is in turn preferably connected to a load cell mounting plate 152 by suitable nut and bolt combinations as illustrated in Figure 14 and as shown in greater detail in Figure 15. The nut and bolt combinations 206, which secure load cell enclosure box 154 to load cell mounting plate 152, are spaced away from and do not contact upstanding members 30 of frame 14. This is illustrated in Figure 15.

Load cell 32 and particularly load cell 150 are connected to frame 14 and specifically to upstanding members 30 by load cell assembly 150 which desirably includes a plurality, preferably two, of mounting bolt/lock nut/grommet combinations, one of which has been designated generally 161 in Figure 14. Mounting bolt or screw 162 extends through load cell mounting plate 152 via a suitable aperture formed therein and also through a suitable apertures in upstanding frame member 30. Mounting bolt on screw is retained in place by a lock nut 166. A rubber grommet 158 is positioned preferably in the hole through load cell mounting plate 152 such that there is no metal-to-metal contact between load cell mounting plate 152 and upstanding frame member 30. Rubber grommet 158 cushions load cell mounting plate 152 with respect to upstanding frame member 30.

Similarly, because rubber grommet 158 has two exterior donut-like portions, designated 200, 202 in Figure 14, and an internal hollow cylindrical portion designated 204 in Figure 14, there is no metal-to-metal contact between mounting screw or bolt 162 and load cell mounting plate 152. The soft rubber of grommet 158 cushions load cell mounting plate 152 against any contact and effectively shock and vibration isolates load cell mounting plate 152 from mounting screw or bolt 162 and hence from upstanding frame member 30.

Referring to Figure 19 where the mounting arrangement for a load cell 32 respecting upstanding frame members 30 in a two load cell gravimetric blender is illustrated, load cell mounting plate 152 is illustrated in Figure 19 as is load cell enclosure box 154. From Figure 19 it is immediately apparent that the mounting bolt/lock nut/grommet combinations 161, which secure load cell mounting plate 152 to upstanding frame members 30, preferably reside in apertures formed in load cell mounting plate 152 which are preferably well removed laterally from load cell 32.

As is further apparent from Figure 19, nut and bolt combinations 206 which secure load cell enclosure box 154 to load cell mounting plate 152 also are preferably well removed laterally from upstanding frame members 30 and hence from mounting bolt/lock nut/grommet combinations 161.

As further illustrated in Figure 19, load cell mounting plate 152 is preferably generally rectangular in configuration and forms what would otherwise be an open side of load cell enclosure box 154. Apertures are provided in load cell enclosure box 154 for passage therethrough of structure connecting the weigh bin to the load cell. In the embodiment illustrated in Figure 14, openings in load cell enclosure box 154 and specifically in vertically upstanding portion 174 thereof are designated 208, 210 for passage of upper and lower generally horizontally extending portions 190, 192 of load transfer beam 170 therethrough.

Figure 16 illustrates another embodiment of a load cell assembly designated generally 150. The embodiment illustrated in Figure 16 is similar to that illustrated in Figure 14 in that load cell 32 is located between upstanding members 30 of frame 14 and a weigh bin 15A, and is further similar to the structure illustrated in Figure 14 in that weigh bin 15A is effectively cantilevered from load cell 32.

The structure in Figure 16 differs from that in Figure 14 in that load cell mounting plate 152 is positioned outboard of upstanding frame members 30. Load cell 32 is clearly inboard of frame members 30, between frame members 30 and weigh bin 15A. The mounting bolt/lock nut/grommet combination 161 is essentially the same as illustrated in Figure 14; a washer 164 is provided in the structure illustrated in Figure 16 to facilitate even application of moderate pressure to grommet 158 upon rotation of lock nut 166 on a shaft portion of mounting bolt 162. The arrangement and relative location of the mounting bolt/lock nut/grommet combinations 161 securing the load cell mounting plate 152 to upstanding frame member 30 and the positions of nut bolt combinations 206 securing load cell enclosure box 154 to load cell mounting plate 152 shown in Figure 16 are preferably essentially the same as depicted in Figure 19 and as discussed above relative to Figure 14.

Figure 17 illustrates yet another embodiment for a single load cell gravimetric blender. The structure in Figure 17 is similar to that illustrated in Figures 14, 15 and 16. However, as is illustrated in Figure 17, grommet 158 of the mounting bolt/lock nut/grommet combination 161 is provided in position about frame member 30, as contrasted to load cell mounting plate 152. In this position grommet 158 prevents any metal-to-metal contact between mounting bolt 162 and upstanding frame member 30.

A washer 172 is provided to distribute force resulting from head 162 pressing against grommet 158.

In the structure illustrated in Figure 17, bolt 162 extends not only through upstanding frame member 30 but past load cell mounting plate 152 and through an aperture formed in vertically upstanding portion 174 of load cell enclosure box 154. Lock nut 166 bears against the exterior surface of vertically upstanding portion 174 of load cell enclosure box 154 as illustrated in Figure 17.

As a further variation in Figure 17 the load transfer plate has been designated 196A and includes an angled tip portion 212 at the upper vertical extremity thereof. Angled tip portion 212 fits against an inwardly facing surface of upper vertically extending extremity of 186 of weigh bin bracket 156 and against a downwardly facing surface of upper end horizontally extending portion 182 of weigh bin bracket 156 to prevent rotation or canting of weigh bin 15B relative to load cell 32 and especially load transfer beam 170. This results in preferably flush, facing contact between vertical portion 180 of weigh bin bracket 156 and load transfer plate 196A. Similarly to the embodiments illustrated in Figures 14 and 16, load transfer plate 196A is fixedly connected to load transfer beam 170 while weigh bin bracket 156 is fixedly connected to weigh bin 15B; some small sliding complemental motion is permitted between load transfer plate 196A and weigh bin bracket 156 to facilitate easy installation of the weigh bin and removal thereof for cleaning.

Such sliding motion is perpendicular to the plane of the paper in Figure 17.

Respecting orientation and relative location of mounting bolt/lock nut/grommet combination 161 vis-a-vis nut/bolt combinations 206 for the structure illustrated in Figure 17, mounting bolt/lock nut/grommet combination 161 is preferably laterally displaced substantially from load cell 32, with a mounting bolt/lock nut/grommet combination 161 positioned on either side of load cell 32 at a common vertical position relative to load cell 32. Nut/bolt combinations 206 are preferably located inboard of the mounting bolt/lock nut/grommet combinations 161B in a manner similar to that illustrated in Figure 19. The load cell enclosure box 154 illustrated in Figure 17 is longer in length longitudinally that illustrated in Figure 19 in order to horizontally overlap to at least some extent the two vertically upstanding members 30 forming a portion of frame 14, in order that grommet 158 and bolt 160 could be positioned in frame member 30 and still engage the facing side of load cell enclosure box 154 as illustrated in Figure 17.

Structure for vibration and shock-isolating load cells 32 from upstanding members 30 of frame 14 in a dual load cell gravimetric blender is illustrated in Figures 13, 18 and 19. A load transfer beam 170-2 is fixedly connected to an upper portion of load cell 32 by suitable screw connectors 214. Load transfer beam 170-2 in the embodiment illustrated in Figures 18 and 19 is of generally inverted U-shaped configuration, having a horizontal portion 216 extending across the top of load cell 32 and having vertically downwardly directed lateral extremities 218, 220.

Load cell 32 is fixedly connected to the bottom of load cell enclosure box 154 via screw connectors 222 illustrated in Figures 18 and 19. Screw connectors 222 which rigidly hold the load cell in position vis-a-vis the load cell enclosure box. Hence the bottom of the load cell is fixed whereas the upper portion of the load cell, where the load is sensed, is free to deflect in response to loads applied as result of material being in the weigh bin. Fitting slidably within apertures, which have not been shown in the drawings, formed in horizontal portion 216 of load transfer beam 170-2 are a pair of hanger screws 224 having long shafts. Each of hanger screws 224 fit slidably through an aperture in horizontal portion 216 of load transfer beam 170-2 with the shaft portions of screws 224 passing slidably through the apertures but the head portions of hanger screws 224 being too large. As a result hanger screws hang freely from horizontal portion 216 of load transfer beam 170-2. Preferably fitted about the shafts of hanger screws 224 are coil springs 160 which serve to provide some bias and resilience in the event hanger screw 224 and/or weigh bin 15, which is suspended therefrom, as illustrated in Figure 13, are jostled.

Located at lower extremities of hanger screws 224 are nut and washer combinations 226. Nuts of combinations 226 are threaded on hanger screws 224.

Supported by the washers of combinations 226 are zig zag brackets 23 which support weigh bin 15.

With this construction the entire weight of weigh bin 15 and any material contained therein is transferred to the washers of combinations 226 by zig-zag brackets 23. This results in transfer of the weight through hanger screws 224 to horizontal portion 216 of load transfer beams 170-2 with load cell 32 thereby being stressed and sensing the weight of bin 15 and any material contained therein.

In the dual load cell embodiment illustrated in Figures 13, 18 and 19 the load cell mounting plate 152 has been depicted outboard of frame members 130.

In Figure 18 grommet 158 has been depicted as being partially occluded by load cell mounting plate 152, for purposes of drawing clarity. Similarly to the other embodiments illustrated, mounting bolt/lock nut/grommet combination 161 isolates load cell mounting structure 150 and particularly load cell mounting plate 152 from shock and vibration which is present in vertical frame members 30, by virtue of rubber grommet 158 completely separating mounting bolt 162 from load cell mounting plate 152 or frame 30; grommet 158 additionally separates load cell mounting plate 152 from frame 30, in the manner described above for the single load cell embodiments.

For both the single and dual load cell versions of the gravimetric blender, grommet-connecting the load cell mounting structure to the load cell mounting plate, in the embodiments in which the grommet engages the load cell mounting plate, or grommet-connecting the load cell mounting structure and mounting plate to the frame members, is best accomplished using just a pair of grommet connectors, aligned along a horizontally extending longitudinal or axial axis. Having the grommet connectors horizontally aligned axis provides an axis about which the load cell (or cells in the dual load cell versions of the gravimetric blender) may slightly rotate in response to the damped vibration or shock loading; the damping results from presence of the grommet(s). This arrangement seems to be superior to mounting arrangements in which the grommet mounts are provided in arrangements which are both horizontally and vertically aligned, such as at the corners of a rectangle, or other arrangements which due to their geometry do not provide for an axis about which the load cell and its mounting structure may move in response to shock and vibration in the frame of the gravimetric blender.

It is important that the mounting bolt not be turned too tightly, compressing the grommet excessively. If the bolt is too tight, the grommet, being highly compressed, has its shock and vibration damping properties compromised. For best results, the mounting bolt should only be tightened to a degree at which the grommet is just showing the slightest bit of visually detectable deformation due to being compressed.

Suitable load cells are available from Tedea Huntleigh, an Israeli company. Model 1010 load cells available from Tedea Huntleigh are particularly suitable.

Grommet 158 is available from NTT/Smith in the United States as part number 920-2170. This grommet has an inside diameter of one quarter inch, an outside diameter of 5/8 of an inch and a groove width of 1/16 of an inch, thereby permitting the grommet to fit easily within load cell mounting plate 152. This grommet has a groove diameter of 3/8 of an inch and an overall thickness of one quarter of an inch.

Suitable solenoid actuated valves are available in the United States under the trademark MAC; the model 45A-L00-DDAA-1BA9 is particularly suitable.

Claims:

1. A method for gravimetrically preparing plastic resin material for manufacturing processing such as molding or extrusion, comprising the steps of:
   a. monitoring weight of material, if any, at a weighing station;
   b. serially metering respective solid resinous materials to said weighing station until preselected weights of said respective materials are at said station;
   c. metering liquid color to said weighing station to join at least one of said materials until a preselected weight of said liquid color is at said station; and
   d. providing said serially metered materials and said preselected weight of liquid color material unitarily to a mixing station;
   e. mixing said unitarily supplied serially metered materials and said preselected weight of liquid color into a blend preparatory to manufacturing processing via molding or extrusion.
2. A gravimetric blender comprising:
   a. a frame;
   b. a hopper supported on said frame;
   c. a weigh bin below said hopper;
   d. means for sensing weight of said bin and any material contained therein;
   e. means connecting said sensing means to said frame for damping vibration therebetween;

f. a liquid color reservoir;

g. a peristaltic pump for drawing liquid color from said reservoir for delivery to said weigh bin;

h. pneumatically actuated means for releasing material within said hopper towards said bin;

i. a mix chamber below said bin including mixing means therewithin;

j. a motor for rotating said mixing means within said chamber;

k. axially self-aligning means for detachably coupling said motor to said mixing means;

l. valve means for actuating said material releasing means by applying pneumatic pressure thereto;

m. means enclosing said valve means for preventing finger actuation thereof;

n. manually articulatable means, adapted for passage through said enclosure means, for actuating said valve means and applying pneumatic pressure to said material releasing means thereby permitting gravity induced flow downward material flow from said hopper into said weigh bin

3. A gravimetric blender comprising:

a. a frame;

b. a weigh bin:

c. means, connected to said frame, for sensing weight of said bin and any material contained therein;

d. a mix chamber below said bin, connected to said frame, including mixing means therewithin;

e. means for selectably releasing material in said bin downwardly into said mix chamber; and

f. means connecting said sensing means to said frame and damping transfer of vibration and shock motion therebetween.

4. The blender of claim 3 wherein said means connecting said sensing means to said frame and damping transfer of vibration and shock motion therebetween includes a plurality of elastomeric members which are horizontally aligned.

5. The blender of claim 4 wherein said elastomeric members are rubber.

6. The blender of claim 3 wherein said frame is metal, said sensing means includes a metal housing and said connecting means connect said metal housing to said metal frame and includes a non-metal elastometric member separating said housing from said frame.

7. The blender of claim 4 wherein elastomeric members are annularly disposed about metal members mutually received by said frame and a mounting portion of said weight sensing means.

8. A gravimetric blender comprising:

a. a frame;

b. a hopper mounted on said frame;

c. a weigh bin connected to said frame below said hopper;

d. load sensing means, mounted on said frame, for sensing weight of material in said weigh bin;

e. a reservoir of liquid color material;

f. a pump for drawing liquid color material from said reservoir and delivering same into said weigh bin;

g. a mix chamber below said weigh pan;

h. means for selectably releasing material in said weigh bin downwardly into said mix chamber.

9. A gravimetric blender comprising:

a. a frame;

b. a hopper supported on said frame;

c. pneumatic piston-actuated means connected to said hopper for releasing material within said hopper towards said pan;

d. spring-biased solenoid valves for actuating said material thereto releasing means by applying pneumatic pressure;

e. means at least partially enclosing said solenoid valves for preventing finger actuation thereof;

f. manually controlled means, adapted for passage through said enclosure means, for overriding bias of springs associated with said solenoid valves and actuating said solenoid valves.

10. A gravimetric blender comprising:

a. a frame

b. a mix chamber including mixing means rotatable therewithin;

c. a motor for rotating said mixing means within said chamber;

d. axially self-aligning means for coupling said motor to said mixing means.

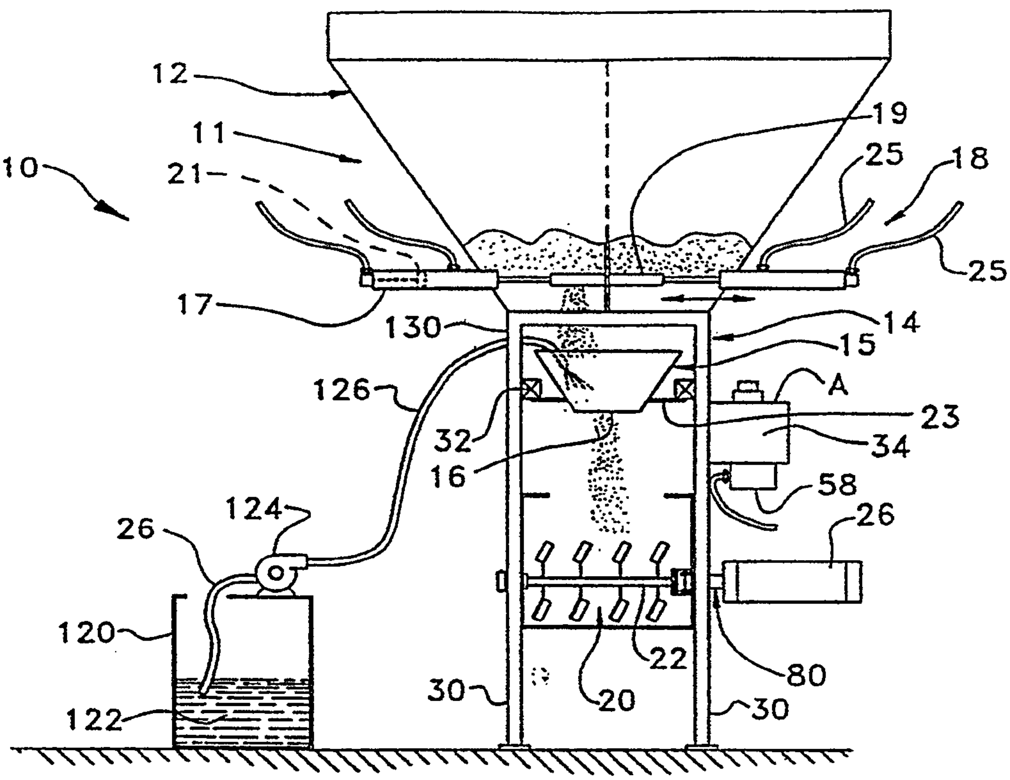

12
11
10
21
19
25
18
25
17
130
14
15
126
A
32
23
34
16
58
124
26
26
120
22
80
30
20
30
122

FIG. 1

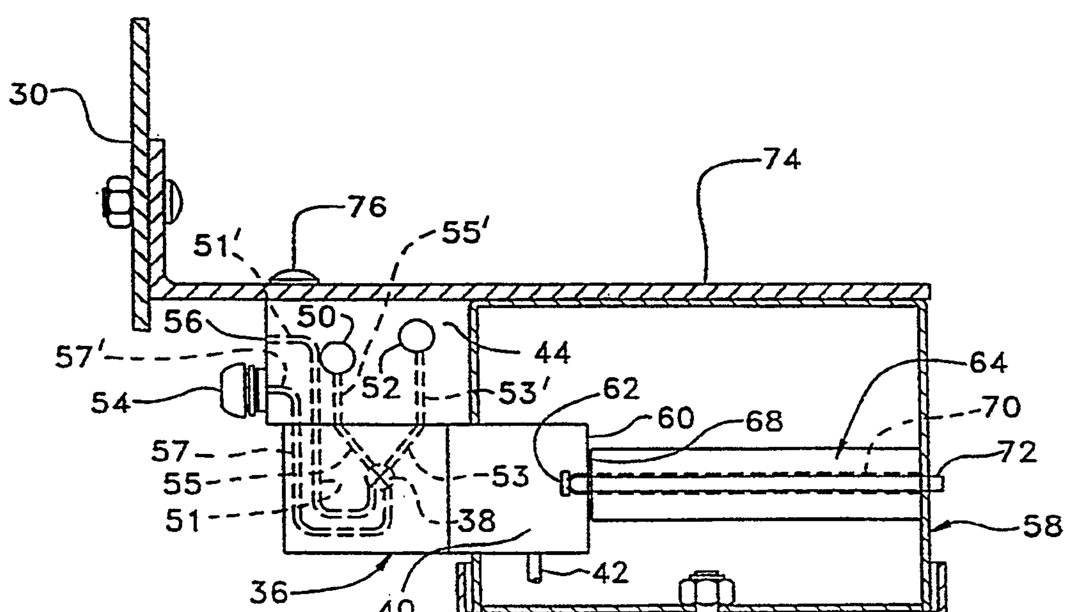

30
74
76
55'
51'
56
50
44
57'
64
52
53'
54
62
60
70
68
57
72
55
53
51
38
58
42
36
40

FIG. 2

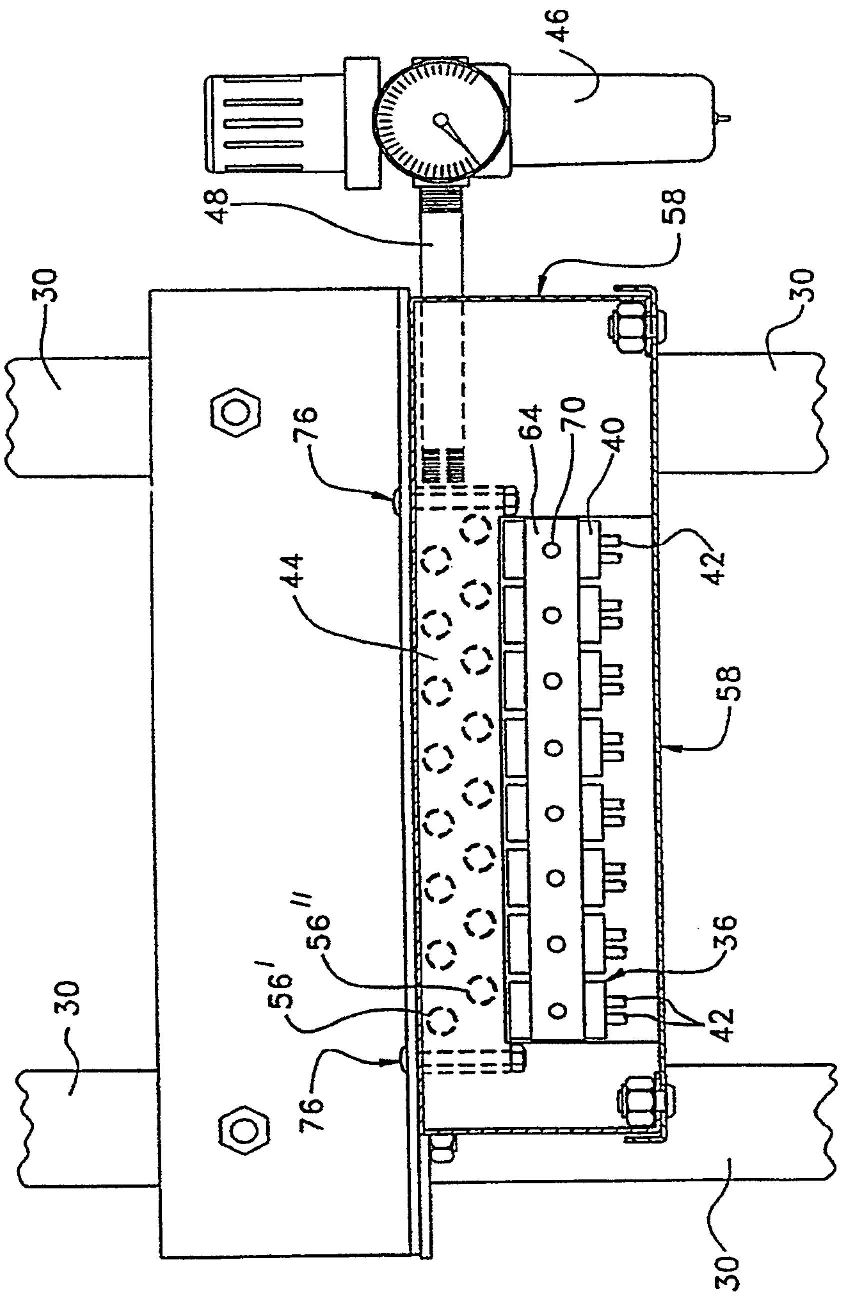


FIG. 3

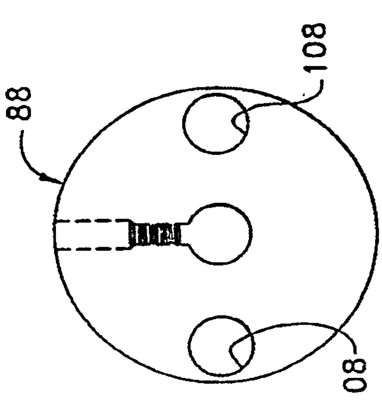


FIG. 4

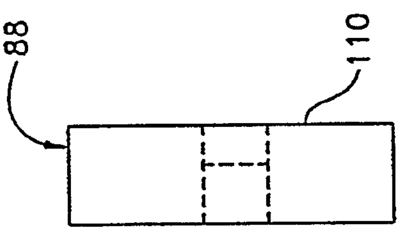


FIG. 5

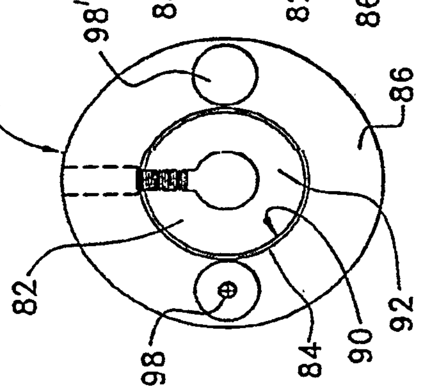


FIG. 6

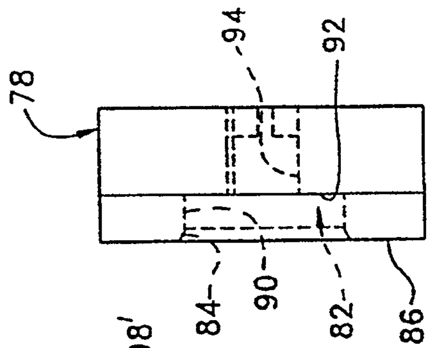


FIG. 7

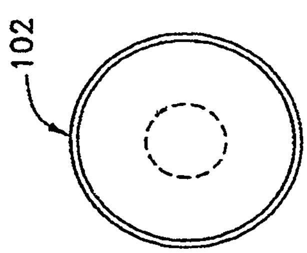


FIG. 8

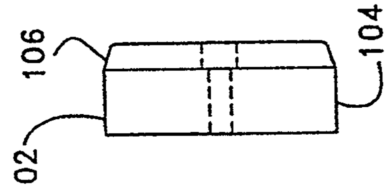


FIG. 9

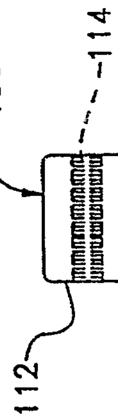


FIG. 10

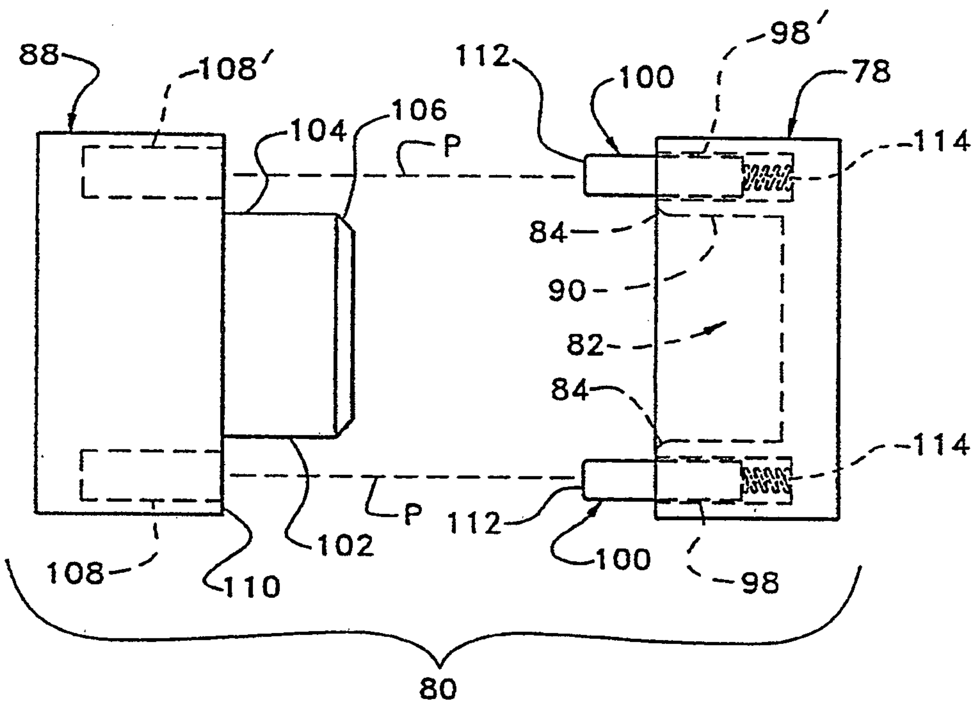

88
108'
104
106
P
112
100
98'
78
114
84
90
82
84
114
108
110
102
P
112
100
98
80

FIG. 11

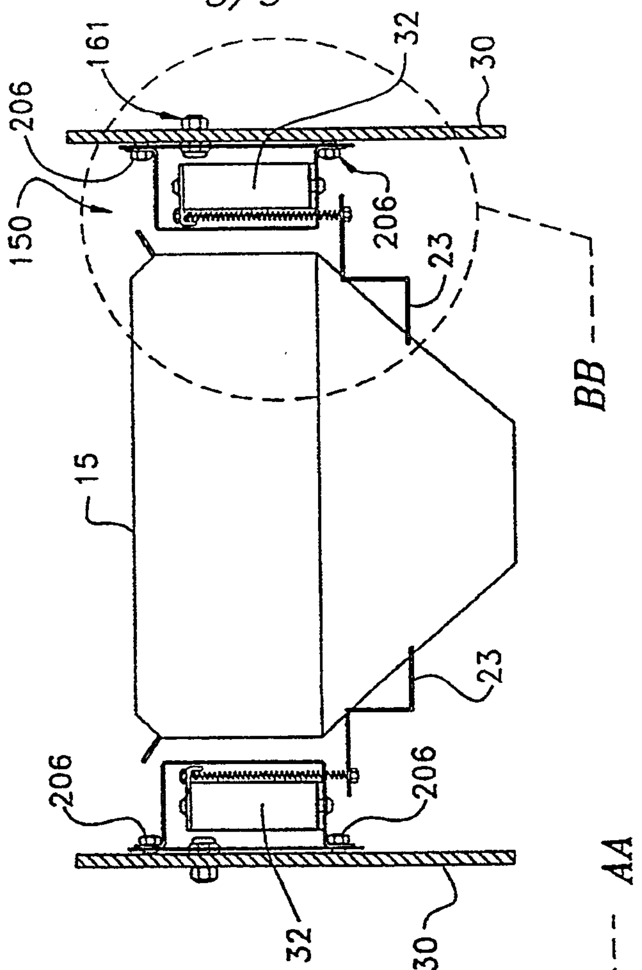

161
32
30
206
150
206
23
15
BB
23
206
206
32
30
AA

FIG. 13

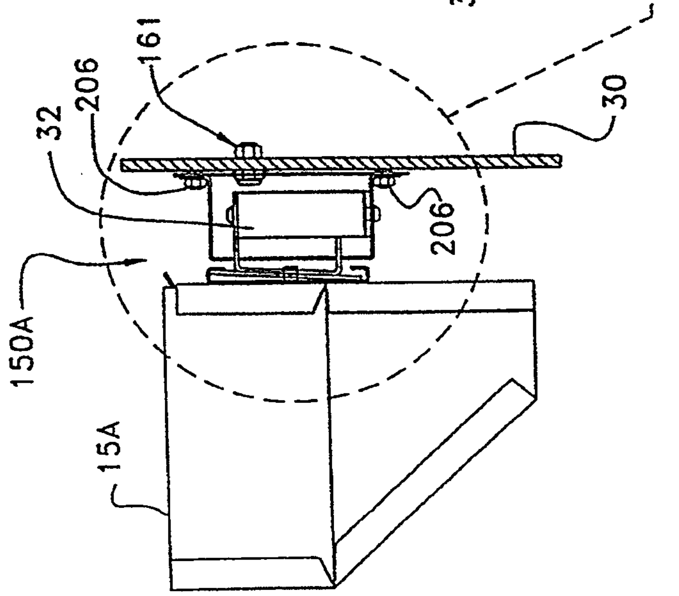

161
206
32
30
206
150A
15A

FIG. 12

6/9

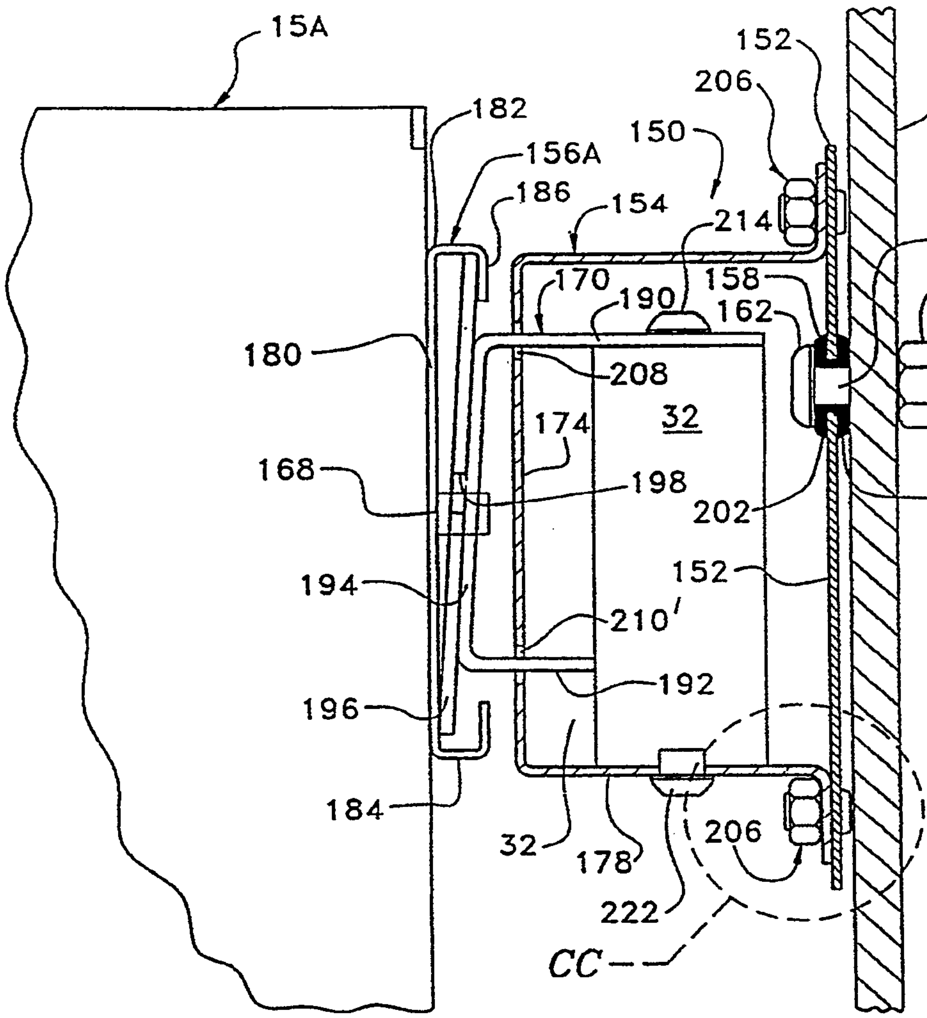


FIG. 14

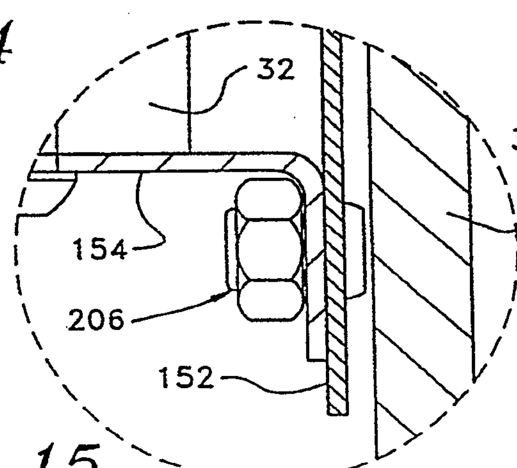


FIG. 15

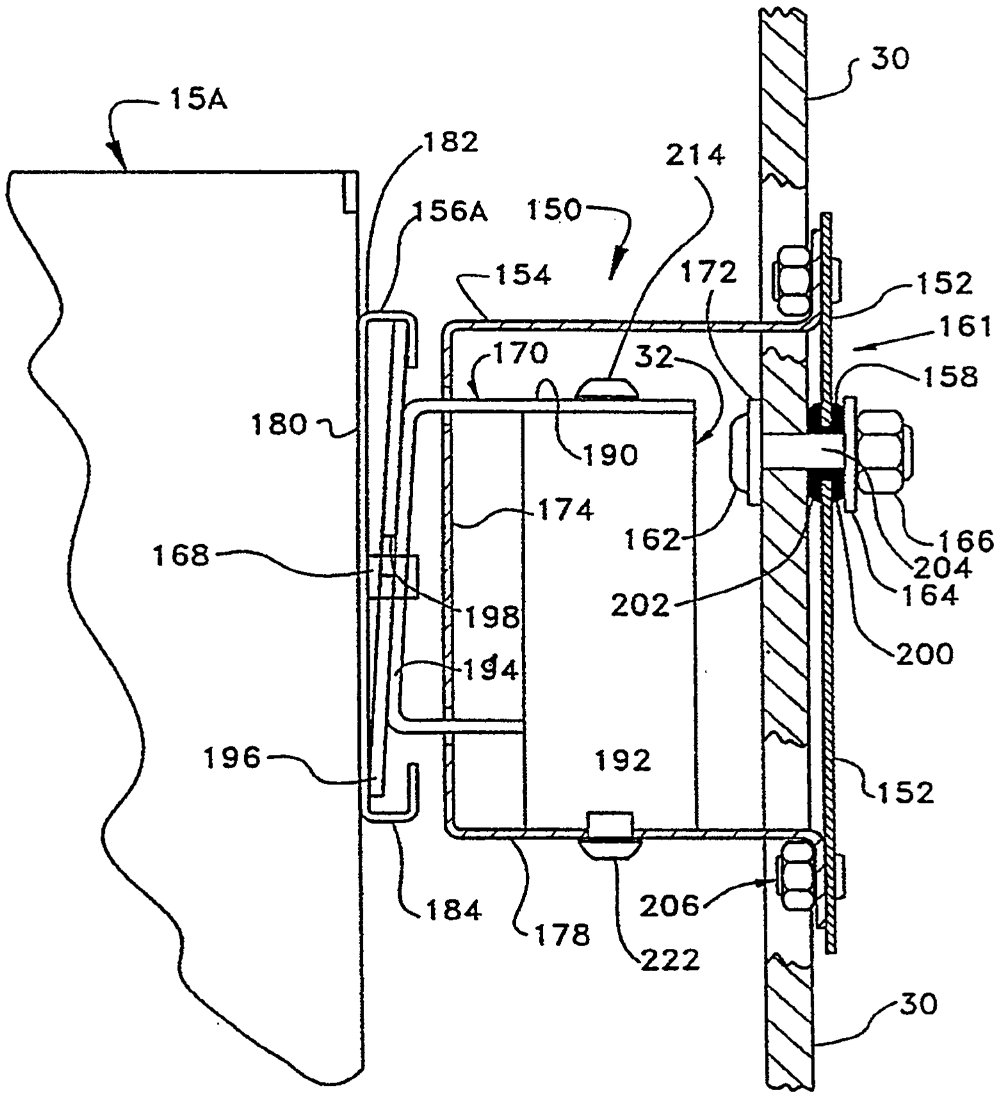

15A
182
156A
150
214
154
172
152
161
170
32
158
180
190
174
166
162
204
168
164
198
202
200
194
196
192
152
184
178
206
222
30
30

FIG. 16

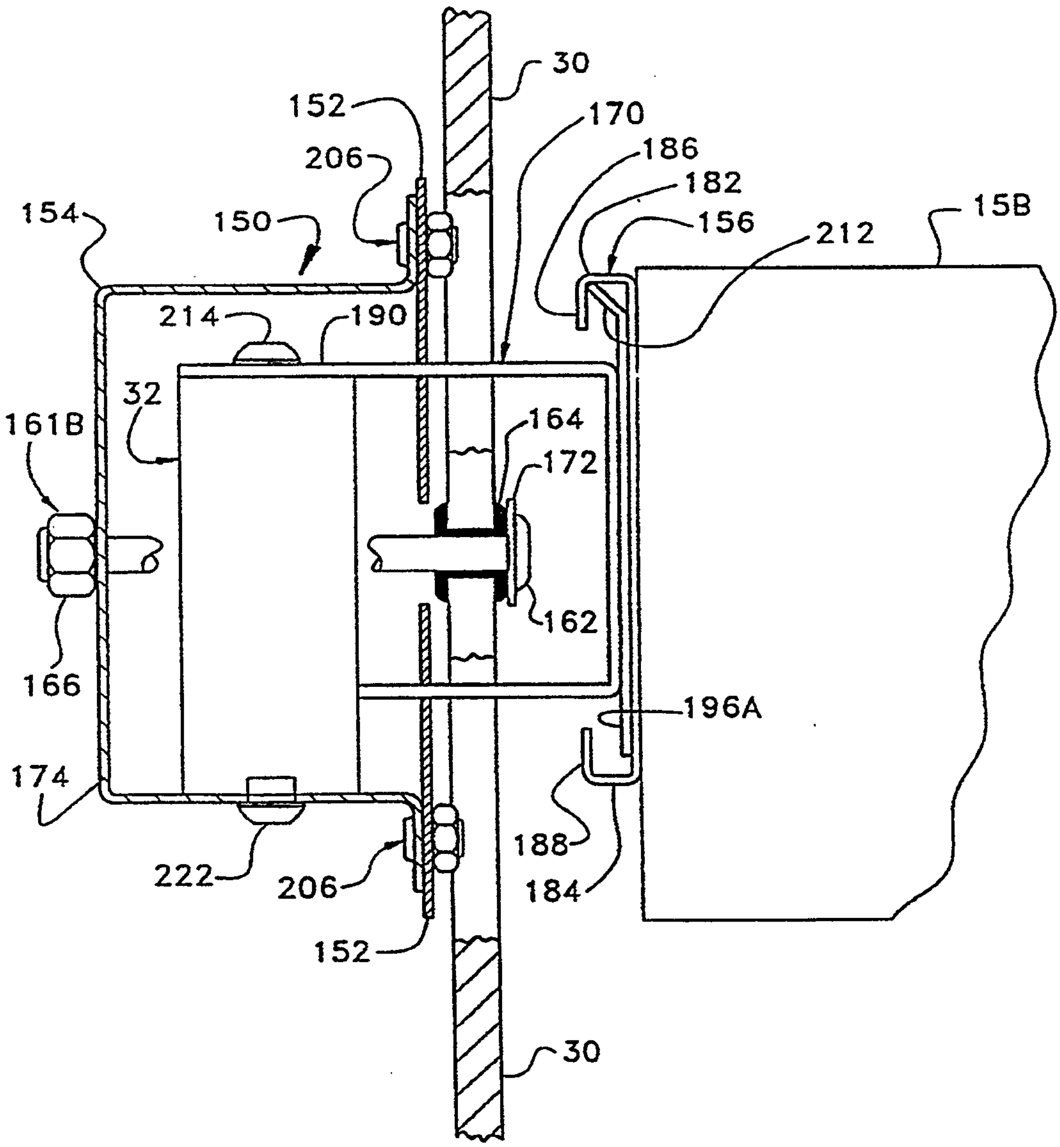

30
152
170
206
186
182
154
150
156
15B
212
214
190
32
161B
164
172
162
166
196A
174
188
184
222
206
152
30

FIG. 17

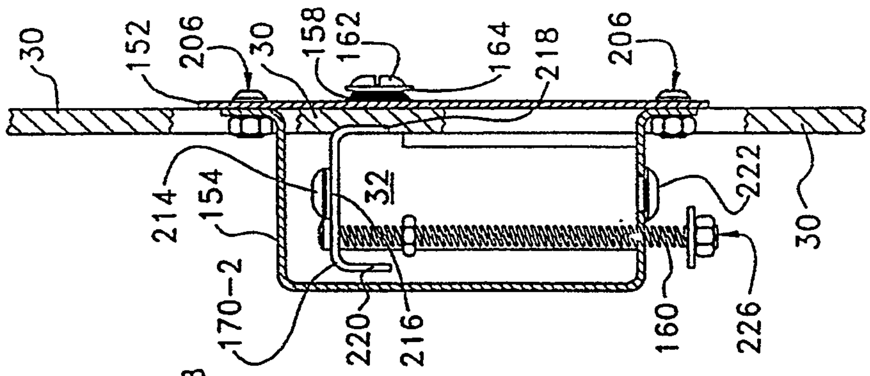

30
152
206
30
158
162
164
218
206
214
154
32
222
170-2
220
216
160
226
30

FIG. 18

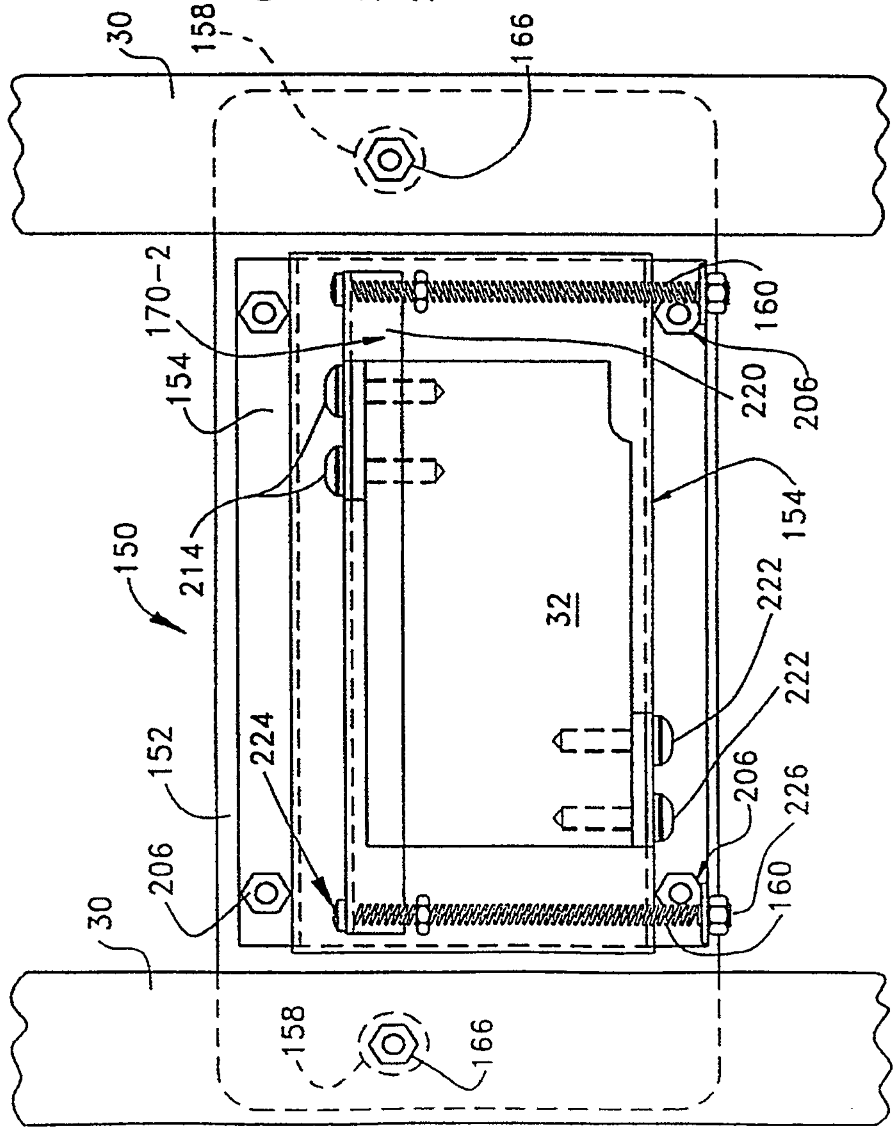
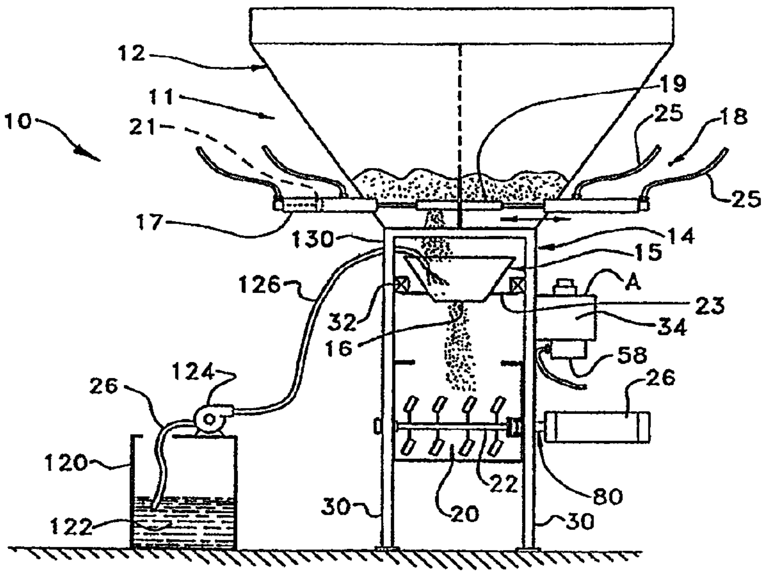

30
158
166
170-2
154
160
220
206
214
154
150
32
222
222
152
224
206
226
206
160
30
158
166

FIG. 19



12
11
10
21
19
25
18
25
17
130
14
15
126
A
23
32
34
16
58
124
26
26
120
22
80
30
20
30
122