Aug. 4, 1942. H. F. HAGEMEYER 2,291,710

DISPENSING MECHANISM AND PROCESS

Filed Feb. 24, 1941 4 Sheets-Sheet 1

FIG. 1.

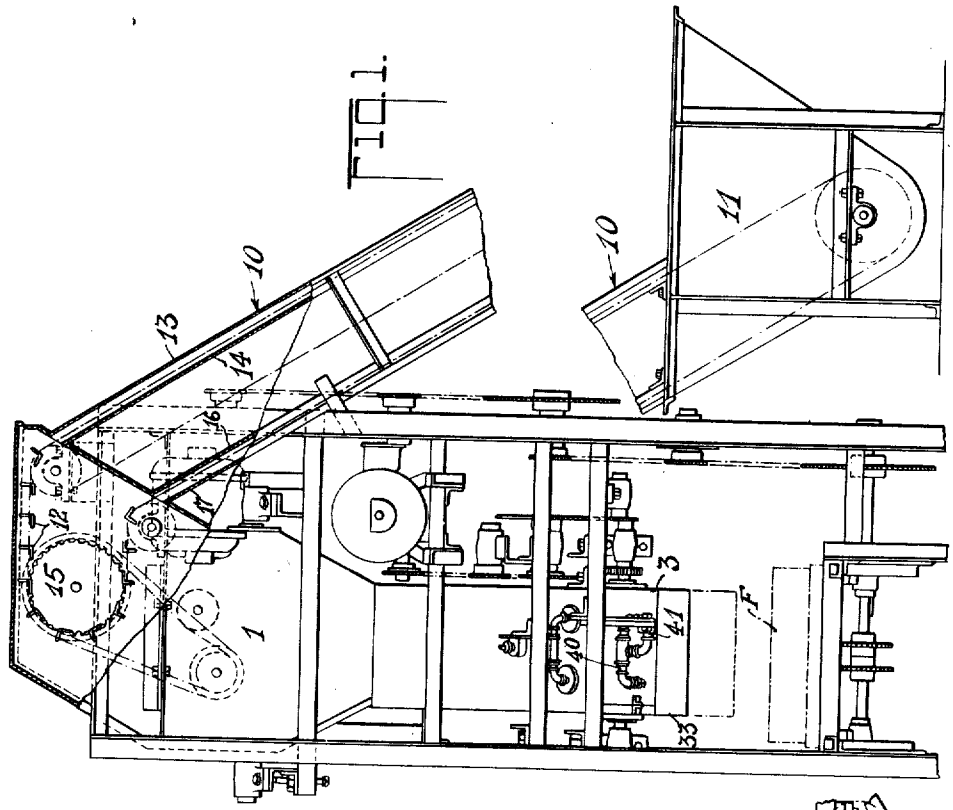
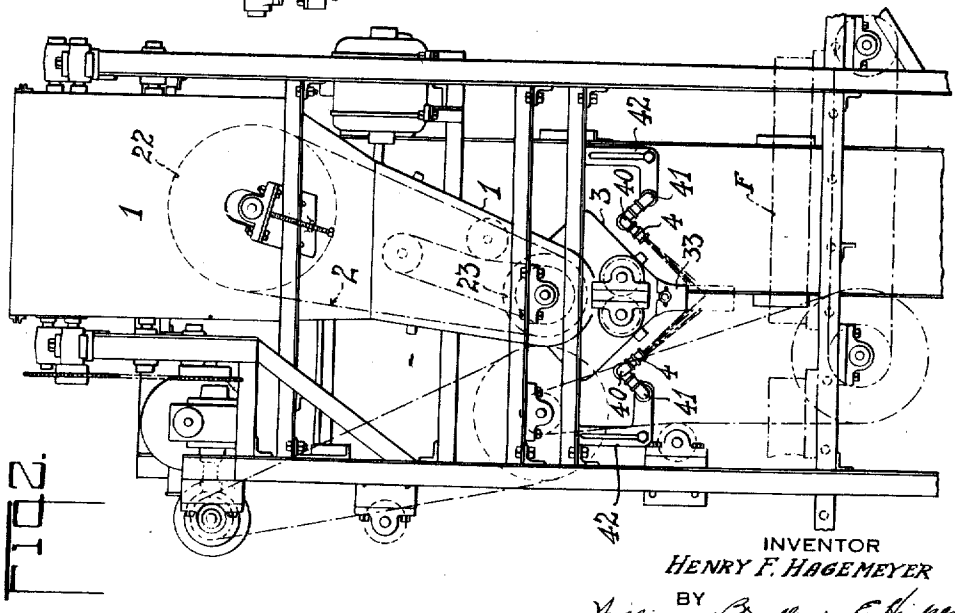


FIG. 2.



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Filed Feb. 24, 1941 4 Sheets-Sheet 2

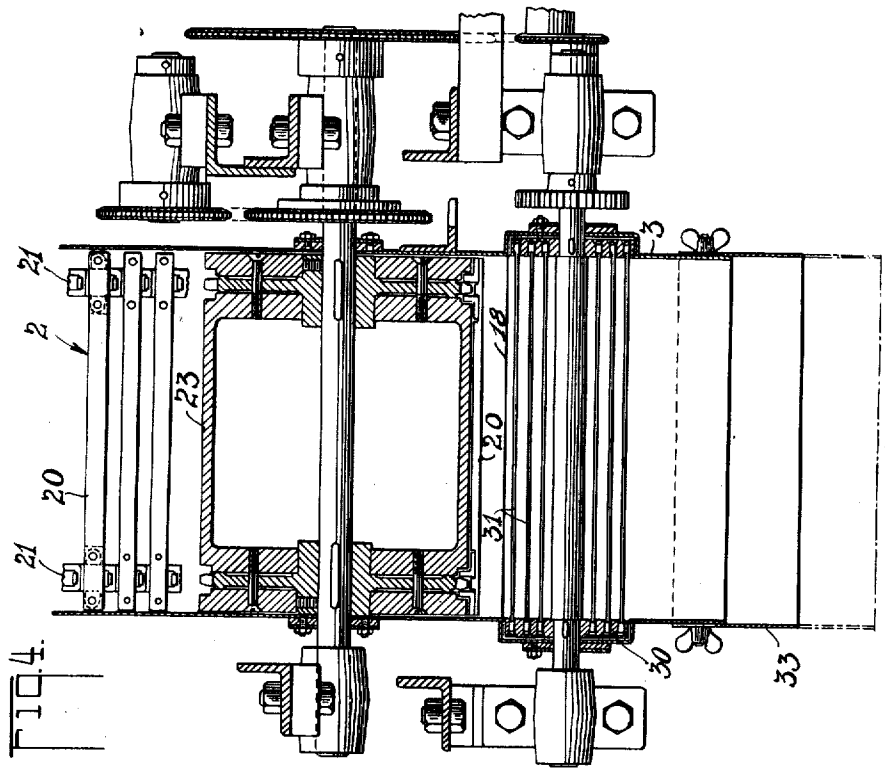


FIG. 4.

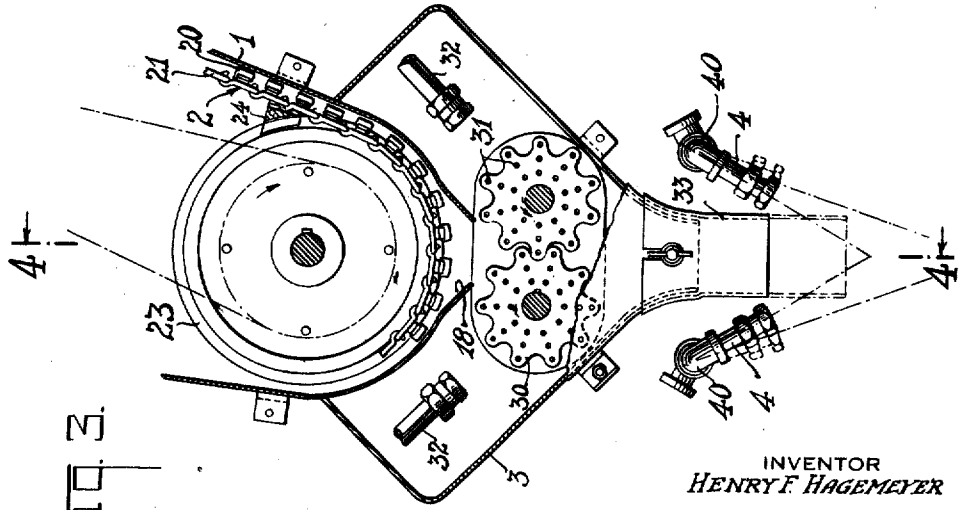


FIG. 2.

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Filed Feb. 24, 1941 4 Sheets-Sheet 3

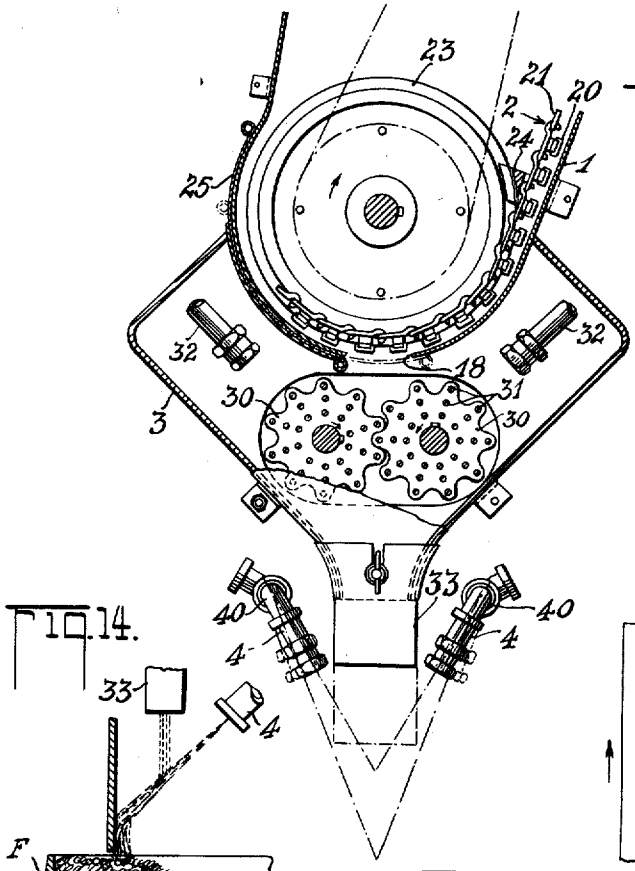


FIG. 5.

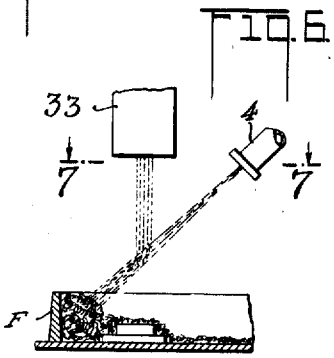


FIG. 6.

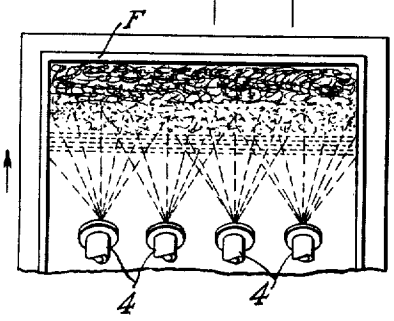


FIG. 7.

FIG. 14.

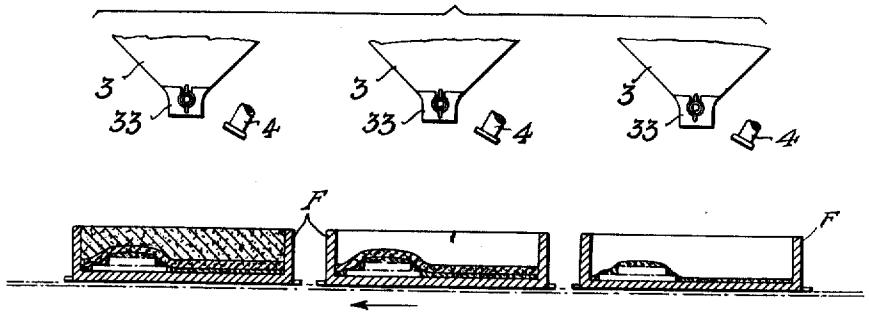


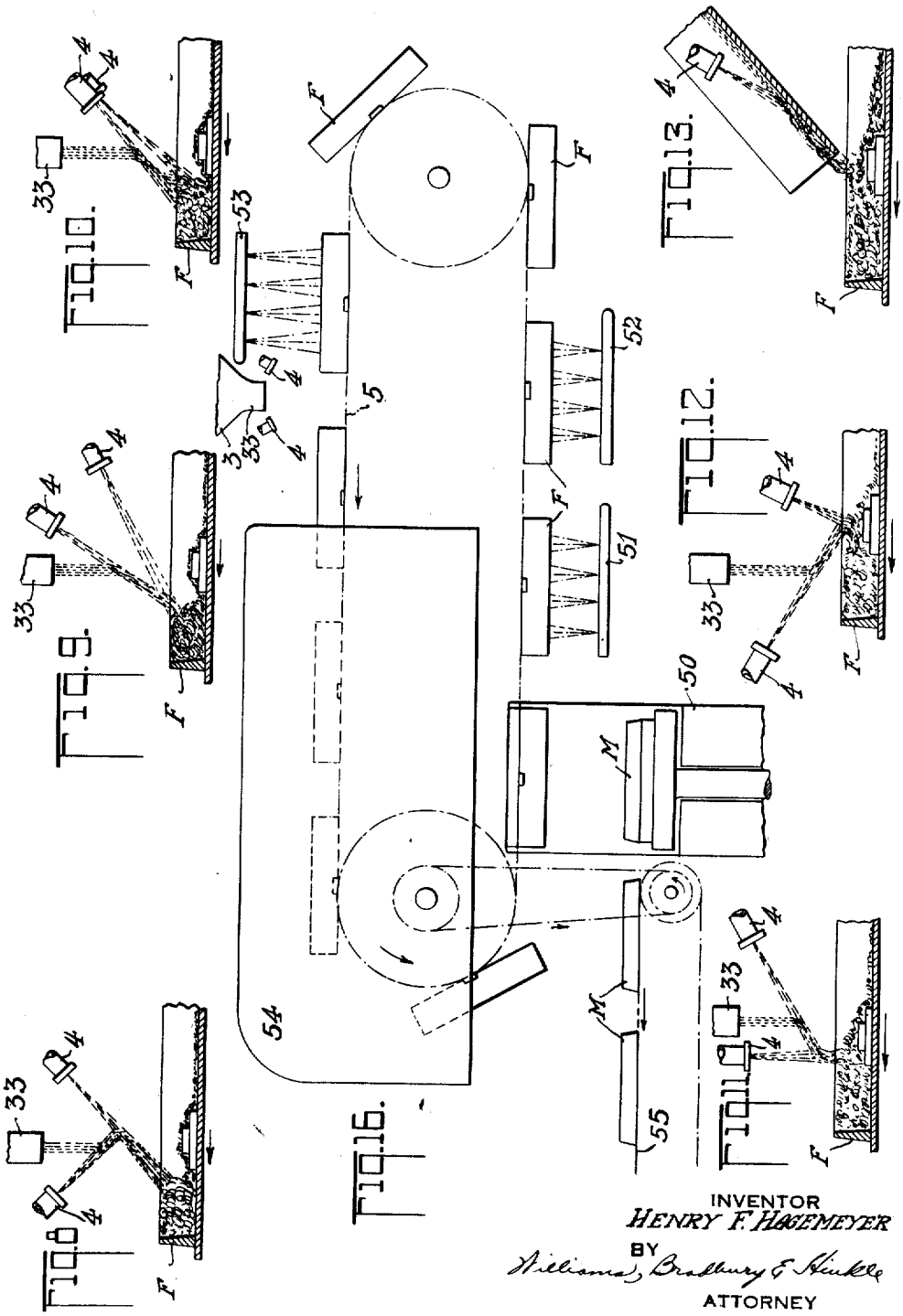
FIG. 15.

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Filed Feb. 24, 1941 4 Sheets-Sheet 4



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Patented Aug. 4, 1942

2,291,710

UNITED STATES PATENT OFFICE

2,291,710

DISPENSING MECHANISM AND PROCESS

Henry F. Hagemeyer, Chicago, Ill., assignor to Castings Patent Corporation, Chicago, Ill., a corporation of Illinois

Application February 24, 1941, Serial No. 380,235

12 Claims. (Cl. 22—9)

My invention relates to material dispensing machines and to methods of employing the same, and more particularly to a machine for mixing powdered material with liquid, and for dispensing measured quantities of the resulting fluid mixture.

While my machine may be employed for mixing various kinds of powdered material with different liquids and for dispensing the resulting fluid mixture, it is particularly well adapted to the manufacture of a gypsum base mold for use in making metal castings. The characteristics of its operation which makes it particularly suitable for such service may also make it valuable for other uses. One important characteristic, for example, is that the fluid mixture dispensed is always fresh, the powdered and liquid ingredients being mixed immediately prior to delivery of the mixture. Such mixture can be produced in a continuous process or the mixture may be dispensed in predetermined batches. The characteristics of the mixture itself may also vary as to consistency and as to the number, kind, and proportions of ingredients used. These various capabilities of my process and machine should be kept in mind in considering the description thereof as adapted particularly to the manufacture of a gypsum base mold.

The main object of the present invention is to provide new and improved mechanism for intimately mixing a powdered material with a liquid medium and depositing such mixture in a receptacle or container with appreciable force.

A further object of the present invention is to provide a new and improved process for preparing a mixture of liquid and powdered material for use as a mold for forming castings.

A further object of the present invention is to provide a new and improved mechanism for delivering powdered material in batches of a definite known weight without the employment of weighing mechanism.

A further object of the present invention is to provide mechanism to dispense a slurry composed of a liquid and powdered material.

Another object is to provide such a machine which may be adjusted quickly and easily to deliver batches of mixture of different size or to vary the consistency of the fluid mixture, and which when so adjusted will maintain such adjustment accurately.

It is desired to effect all these objects by a machine of simple construction and one having the fewest possible number of moving parts, yet one in which the accuracy of measurement of the various ingredients and the thoroughness of mixing will be high.

Independently of my disclosed mechanism, it is an object to devise an efficient dispensing and mixing method in which powdered and liquid materials may be separately dispensed, mixed in transit, and the final mixture having predetermined composition, consistency, and characteristics delivered.

Other objects, and in particular those inherent in unique manipulations of my process and in specific features of my mechanism will be understood from the following description of the details of my invention.

Preferred embodiments of my invention shown in the drawings illustrate the principles of my process and the general operating characteristics of my machine. It will be understood that various alterations in the forms and details of my device disclosed may be desirable as dictated by good engineering design to adapt it to specific uses and installations, without departing from the spirit of my invention as herein described, and as defined in the appended claims.

Fig. 1 is a front elevation view, parts thereof being in section, and

Fig. 2 is a side elevation view of my machine.

Fig. 3 is an enlarged view partly in vertical section and partly in side elevation of the comminuting and spray elements of my mechanism.

Fig. 4 is a vertical section taken along line 4—4 of Fig. 3.

Fig. 5 is a view similar to Fig. 3 of a modified form of my device, partially in vertical section and partially in side elevation.

Fig. 6 is a side elevation view with parts in section, showing somewhat diagrammatically a nozzle arrangement and the relation of the powdered material and liquid spray sheets, and

Fig. 7 is a section taken along line 7—7 of Fig. 6 showing in plan the nozzle spray arrangement and its operation.

Figs. 8 to 14, inclusive, are side elevation views with parts in section, showing different spray nozzle arrangements in diagrammatic fashion.

Fig. 15 is a diagrammatic illustration of a multiple stage dispensing mechanism.

Fig. 16 is a diagrammatic view of a mold production line incorporating my dispensing apparatus.

While, as has been pointed out heretofore, my dispensing machine is useful in various instances where it is desired to deliver a fluid mixture, I have found it to be particularly useful in the pro-

duction of gypsum base molds used in the manufacture of metal castings. For purposes of illustration, therefore, my process and the construction and operation of a machine capable of performing such process will be described with reference to such mold manufacture.

In making gypsum base molds it has been the practice to weigh out or measure separately the quantity of dry, powdered, gypsum base material and the amount of water required for an individual mold. This measuring step has been followed by a mixing operation in which the plaster and water were commingled into a homogeneous fluid. The third step was to deposit this known quantity of mixture in a flask containing a pattern where it set. Such series of operations was inefficient. In the first place considerable time was expended in each of the manually performed weighing, mixing, and depositing steps. Eventually the process was simplified by combining the mixing and settling. In a flask were placed known amounts of the dry, gypsum base material and water, and these ingredients were mixed in the flask itself which mixing action served the further purpose of settling the mixture intimately about the patterns in the flask. The efficiency of the operation could be somewhat improved by using automatic weighing or measuring mechanism for separately dispensing the powdered material and the liquid. But three steps would still be required, namely, the weighing and depositing of the water in the flask, the weighing and depositing of the gypsum base material in the flask, and finally the mixing and settling of the mixture within the flask.

The present invention seeks to combine these several steps into a single operation, capable of being carried out by a single apparatus which simultaneously will

(1) Measure and deliver progressively a predetermined weight of powdered gypsum base material,

(2) Deliver at a constant rate and velocity a predetermined quantity of liquid, such as water,

(3) Intimately and homogeneously mix the powdered and liquid ingredients into a fluid mixture of predetermined consistency, and

(4) Dynamically deposit such fluid mixture in a flask so that it will be settled about the patterns therein.

Not only will this operation save time but the mold produced by this method will be superior since the mixture will be deposited in its final position about the patterns more quickly, and hence while the mixture is in a more highly fluid condition, so that it will conform more accurately to minute details of the patterns. Moreover the molding operation as a whole may be further expedited by employing an accelerating agent, a number of these being known to the art, for shortening the setting time required even more than it may safely be decreased where the ingredients are mixed in the flask.

In the manufacture of gypsum base molds a continuous supply of the powdered material will be required, which will ordinarily include calcined gypsum and a filler such as short fibre asbestos, talc, or other inert material in substantially powder form. The mixing liquid, which will ordinarily be water, is delivered to my machine under a desired constant pressure, maintainable by any suitable mechanism. The final mixture will preferably be deposited in a series of flask rim and matchplate assemblies as they move along beneath the machine, the quantity delivered into each flask assembly being accurately measured. The machine is regulated to dispense successive mixture batches of equal weight into successive flasks, such mixture being progressively driven onto each matchplate and about the patterns thereon, and distributed uniformly throughout the length of the flask during its travel.

It will be understood that the various steps of my process are carried out concurrently, although for the purpose of clarity they will be described separately. The first step involves the production of a falling sheet of powdered material, which, for mold purposes, will ordinarily be primarily calcined gypsum. This powdered material may fall freely in a sheet of considerable width, for example ten or twelve inches, while it will be of very slight thickness, probably only about a quarter of an inch. While the material preferably falls freely, it may instead be dispensed as a sheet sliding down an inclined chute. The material should be of uniform density, in addition to the sheet being of constant width and thickness, so that the material is dispensed at a constant rate. It is not necessary that the sheet be exactly the same density at every point throughout its length as long as it is substantially uniform in character. Thus the sheet may be composed of successive equal parcels, portions, or increments of material moving in close succession, so that for practical purposes it may be treated as a continuous and uniform sheet. If the material has a tendency to pack or clot it should be comminuted, so that all such clots are broken up, before the sheet meets the liquid spray. Such fluffing operation may also serve to smooth out the periodic inequalities in the sheet so that it will be continuously uniform.

While the dry powdered material is thus being delivered in a substantially uniform falling sheet, the mixing liquid, which is ordinarily water, is delivered in a downwardly directed spray against the sheet of powdered material. Within the term "sheet" as used with reference to the falling powdered material and the liquid spray I intend to include not only absolutely planar formations, but also formations of considerable width and slight thickness which may be somewhat arched or bowed transversely of their directional movements, although such sheets may be considered to be generally planar. The sheet spray is directed downwardly against the powdered material sheet at an acute angle thereto, the planes generally defined thereby preferably meeting in a substantially horizontal line. The powdered material and liquid merge and intimately commingle to form a homogeneous fluid mixture. If the powdered material is primarily calcined gypsum it has been found that more thorough mixing will result if the water is delivered at a temperature in the range of about 140° F. to 160° F. The temperature of the resulting fluid mixture will, of course, be below this range if the powdered material is unheated. If the powdered material is dispensed as a freely falling sheet the force of the liquid spray will act as a barrier to interrupt and to dissipate such sheet. The intercepted powdered material will be deflected by the sheet spray and such material will be entrained in it. With the nozzle arrangement shown in Fig. 6, for example, the course of the spray will be little affected by its assimilation of the powdered material. Where

the powdered material is dispensed in the form of a sheet sliding down a chute, however, the liquid spray striking the chute at an acute angle will be deflected by its impact and the mixture will continue downward along the chute at an accelerated speed, but the dry and liquid ingredients will still become intimately commingled.

According to the requirements of the operation and the particular installation, any one of a large variety of nozzle arrangements and positions may be employed. It may be required, for example, to mix together several dry ingredients with a single liquid. This may be accomplished by feeding sheets of the various powdered materials down chutes to merge into a single composite sheet prior to contact with the liquid, or such different powdered materials may be dispensed in parallel sheets falling into the liquid sheet spray at different positions along its length and cumulatively entrained thereby. A third alternative is to feed the various dry ingredients each into a separate liquid spray in which it will be entrained, after which the several liquid sprays may be merged prior to deposit of the ultimate mixture. If several different liquid ingredients are required, each may be dispensed from a separate nozzle. The sprays from such nozzles may all lie in the same plane as shown in Figs. 6 and 7, and the sprays may overlap laterally as in Fig. 7, so that the liquids become somewhat mixed before they come into contact with the dry material. Another possible arrangement is that shown in Fig. 2 in which the nozzles on one side of the falling powdered material sheet may deliver a spray of one liquid while the nozzles on the other side deliver a spray of a different liquid. The same plan may be carried out with the separate sets of nozzles arranged as shown in Figs. 8 and 9. In all these situations the size of the powdered material sheets and the force and volume of the liquid sprays will be regulated according to the proportions of the several dry and liquid ingredients desired in the ultimate mixture. Obviously a fluid mixture containing several different types of powdered material and also several different liquids could be produced by a suitable combination of powdered material sheets and liquid sheet sprays, arranged to finally merge into a single stream, according to these plans.

In the making of gypsum base molds by my process it is desired not only that the proper mixture be dispensed but that it be dispensed directly into a flask and matchplate assembly in such a manner and with such force that the mixture will fill the details of the patterns and lie uniformly over the surface of the matchplate. Especially where gypsum base molding material is used it is essential that slight wrinkles and bubbles on the parting surface of the mold be avoided. Such wrinkles often occur when a fluid mixture is merely poured onto a matchplate, and such bubbles occur where the material on the matchplate surface is aerated. It is therefore desirable to dynamically deposit the fluid mixture onto the matchplate and about the patterns thereon, rather than merely allowing it to flow onto such matchplate only under the force of gravity. The force with which the liquid is sprayed should be enough not only to entrain and mix intimately with the dry material, but sufficient residual force should be available to drive the final mixture onto the matchplate sufficiently to settle it closely about the patterns to fill every crevice and detail thereof.

It will be understood by one skilled in the art that in such a mixture dispensing process the temperature of the ingredients, the use of a powdered material chute or its omission, the height of the nozzles above the container in which the mixture is deposited, the angle between the powdered material sheet and the sheet spray, the proximity of the spray nozzle to the dry material sheet, the dimensions and shapes of the powdered material sheet and sheet spray, the velocity of the falling powdered material, the force with which the liquid is delivered, the number, capacity and type of nozzles employed, the degree of overlap of the nozzle sprays, the number and arrangement of spray planes, the number of powdered material sheets, the angle of the spray fan delivered by each nozzle if more than one are used, the relative arrangement of the several nozzle lines, and the time required for delivery of a batch of given weight may all be varied according to the number and kinds of liquids and powdered materials dispensed, the fluidity or consistency of the ultimate mix, the direction and force with which the final mixture is to be delivered, and special considerations, such as the avoidance of bubbles and other imperfections on the matchplate surface of a mold.

Various typical nozzle arrangements which may be used in my process as applied to the formation of gypsum base molds for making metal castings are illustrated in the drawings. The simplest is shown in Fig. 6, which may consist of one nozzle delivering a sheet spray of liquid directed downwardly toward the powdered material sheet to meet it at an acute angle. A single row of nozzles, each emitting a planar, fan-shaped spray, and arranged so that the spray fans overlap laterally, as shown in Fig. 7, but all disposed in a single plane might alternatively be used, which would also have the profile of Fig. 6. If the sheet of powdered material is somewhat thinner in the center than at the edges it might be desirable to use nozzles of larger size for the center than for the outside. The number of nozzles in the row will, of course, be selected according to the desired degree of overlap and the total width of the powdered material sheet. It has been found that under some conditions aeration of the mixture on the matchplate surface is decreased and parting surface bubbles virtually eliminated by driving the mixture along the matchplate by a spray meeting the powdered material sheet at a relatively large angle, and making a small angle with the matchplate surface. Such action apparently wipes off bubbles of air clinging to the matchplate.

Under certain circumstances two sets of nozzles may be required to deliver a large enough quantity of liquid at a sufficiently low pressure or in a fine enough spray. In such cases one of the arrangements shown in Figs. 2, 8, 9 and 10 may be used. With the arrangement of Fig. 2, also shown in Figs. 3 and 5, nozzle sprays strike the powdered material from both sides and at substantially the same location. The sprays are thus largely interrupted, the powdered material sheet is dissipated at the junction of the sprays, and the mixture drops straight down into the container below in a rather wide band. In Fig. 8 one set of nozzles delivers a spray directly against the sheet of powdered material to entrain such material, and the mixture thus formed is thereafter struck and deflected by the liquid spray from the second set of nozzles. The liquid of the second spray mixes with the primary mix-

ture and this final mixture is deposited onto the matchplate. The number of nozzles in each row may be varied as discussed in the description of Figs. 6 and 7.

If it is desired to deposit the final mixture onto the matchplate at a relatively flat angle but with little force, the nozzle arrangement of Fig. 9 may be used. Here two sets of nozzles are employed, both delivering sprays having a relatively low velocity. If only one set of nozzles were used the force of the spray delivered at a large angle to the powdered material sheet might not be sufficient to completely entrain such material. The first row of nozzles is therefore set to deliver a spray at a small angle, say 30° to the powdered material sheet. Even a low pressure spray at such an angle will entrain the powdered material and deflect it from its vertical course through such angle. The second row of nozzles will then be set at a much larger angle, for instance 60° to the powdered material sheet, and this sheet spray, though of low velocity, will deflect the primary mixture through another 30°, so that the final mixture meets the matchplate at an angle of only 30° although its velocity is comparatively low.

Another expedient which may be employed where sprays of low velocity are desired is that shown in Fig. 10. Here the nozzles may all be fed from the same conduit but some will be arranged to deliver a sheet spray in a plane above that of the sheet spray delivered by other nozzles. The upper spray sheet will thus form a preliminary mixture with the powdered material, but it either will not be completely entrained in the upper spray, or the mixture will not be fully deflected to follow the course of such upper spray. The preliminary mixture and any powdered material falling through the first spray will be entrained by the second spray, which will complete the deflection of the powdered material sheet from its original course, so that its final direction will be that of the lower sheet spray.

In some cases it may be desirable to deposit the mixture substantially vertically onto the matchplate but with relatively little force. Such operation is of advantage where the patterns contain deep cavities which would not be filled as well by a mixing stream moving at a flat angle to the matchplate. If a nozzle arrangement such as shown in Figs. 6 and 7 were employed, disposed at a very small angle to the powdered material sheet, the desired direction of deposit would be obtained but the force would be too great, since the velocity of the liquid spray would have to be high in order to obtain a proper mixing action with the powdered material which would be moving in nearly the same direction as the spray. In the arrangement of Figs. 11 and 12 the primary mixture is formed by a spray sheet delivering the major portion of the mixing liquid required, which is disposed at a fairly large angle to the powdered material sheet. The velocity of this spray need not be as great as would be required for a more nearly vertical spray, since it is not traveling in so nearly the same direction as the powdered material. The spray will have a volume sufficiently large to entrain the powdered material. The preliminary mixture is then deflected to an almost vertical direction with respect to the matchplates, taking into consideration the transverse movement of the flask, by a nozzle or a line of nozzles delivering a sheet spray almost directly downward against the initial mixture sheet. In determining the exact direction of the secondary spray the angle between the primary spray and the powdered material sheet, the direction and speed of movement of the flask with respect to the two sprays, the distance from the powdered material sheet to the secondary spray line, and the volume and velocity of the secondary spray compared to the flow of mixture must be taken into consideration.

Another arrangement which, though not restricted to such conditions, will deliver a mixture at a very low velocity is shown in Fig. 13. Here the powdered material does not fall freely but slides in a sheet down an inclined trough or spout. The nozzles are arranged above the spout and directed downwardly toward it so that the sheet delivered thereby meets the powdered material sheet at an acute angle and preferably along a horizontal line. With this arrangement the spray upon striking the trough will be deflected from its course to a direction substantially along such trough, whereas the powdered material sheet will continue its original direction of movement. Although the powdered material will be accelerated by the force of the liquid spray, the apparatus may be arranged so that the mixture formed will fall with very little velocity from the end of the trough. A high speed and force of deposit may also be obtained with this structure, if desired, by increasing the velocity of spray, by decreasing the angle between the spray and the trough, by tipping the trough toward the vertical, and/or by shortening the trough. By such adjustments any direction and force may be diven to the mixture dispensed.

A modification of the trough type of mechanism is illustrated in Fig. 14. Here the trough has been tilted until it is precisely vertical and the powdered material sheet falls freely, parallel and adjacent to it. The liquid spray is supplied by nozzles on the side of the powdered material sheet opposite the trough. When used in this fashion the trough may become simply a flat plate, as shown, since it need not function to restrain lateral movement of the powdered material. Again the liquid spray may be directed against the powdered material sheet at any desired angle and with any force which may be appropriate to produce the proper final mixture. Also the spacing between the trough or plate, which in this arrangement really acts as a baffle, may be varied to produce the best possible mixing action. The mixture produced by the spray and entrained powdered material striking the baffle will be dispensed almost directly downward with greater or less velocity according to the sheet spray and plate position selected. Thus the action of the baffle plate is quite similar to that of the curtain spray sheets of Figs. 11 and 12 except that it is more positive in action. When a baffle plate is used the spray with the plaster entrained will be interrupted and deflected downward no matter what its force, whereas when a curtain spray is used the main spray cannot have a very great force if the curtain spray is to interrupt and deflect it in the manner intended. It will be evident that, as a variation, the baffle plate may be disposed at a slight angle to the vertical, either sloping downward away from the powdered material sheet or toward it to a slight extent.

Where my process is used for making gypsum base molds it may be desirable to form laminations having different refractive characteristics. Thus, for example, the parting surface layer may have high heat resistant characteristics but be

relatively dense and non-porous. The main body of the mold need not have such high heat resistant qualities but should be more porous to give a high venting rate. Such a stage molding process is illustrated in Fig. 15. In the dispensing of a mixture into a flask it is preferred in any case that the flask be moved along beneath the stream of fluid mixture so that it will be driven progressively onto the matchplate and about the patterns rather than the entire batch of mixture being delivered onto one part and required to flow without any driving force over the rest of the matchplate. Where a coating only is to be deposited first, as in the right hand position of Fig. 15, the speed of flask movement will be proportionate to the rate at which the mixture is dispensed, so that a uniform coating over the entire matchplate will be produced in its travel. Such coating should have clinging characteristics sufficient to cover the patterns entirely, whatever their shape, with a thin layer of substantially uniform thickness. If the mold is to have three laminations, such as illustrated in Fig. 15, during the second stage a further layer of substantially uniform thickness, but usually thicker than the first, will be deposited, and the flask will thereafter be filled to the desired height with a third type of mixture. Obviously the number of layers may be varied according to the characteristics which the finished mold is to have. Ordinarily two layers of material will be sufficient, but more than three layers may be required in certain circumstances.

While it is very important that the coating layer be deposited so that there will be no bubbles or other faults on the parting surface of the mold the backing layers need not be applied in such a careful manner. Hence it may be practical to deposit only the first coating by my process and the subsequent layers may be formed by merely pouring in, rather than driving in, a fluid mixture. If a driving force is required to give sufficient bonding between the mold layers. however, then my process should also be used for depositing the backing layers. Even if not required for this reason economical and expeditious production would dictate the use of my process for depositing all layers in a continuous molding operation. Between each molding stage the flask will ordinarily remain stationary for a short interval to allow each under layer to set partially before the next layer is deposited on it. Satisfactory definition and individuality of the several layers will thus be retained.

An apparatus which I have devised for carrying out my process consists principally of a storage bin 1 for the powdered material in the lower portion of which runs a measuring belt 2. The storage bin may be filled from a hopper on top, or it may be completely enclosed and filled by a conveyor or elevator 10 of a modified bucket type. This conveyor may hoist the powdered material for the mixture from a hopper 11. It consists of angle iron scraper members or bars 12 which are carried down into the body of material in the hopper and thence pass upward between walls 13 and 14 spaced apart just enough to afford clearance for such bars. The conveyor belt passes over a drum 15 within the storage bin 1 and thence back down to the hopper 11 between walls 16 and 17, also spaced apart just sufficiently to enable bars 12 to pass therebetween. The capacity of feed conveyor 10 is preferably slightly greater than the maximum capacity of measuring belt 2 so that the storage bin 1 will be maintained completely filled at all times. Any material carried up to the storage bin which is not necessary to replenish it is drawn downward by the returning bars 12 back into the hopper, so that the storage bin will never be packed by the supply conveyor forcing an excessive amount of material into it. Suitable mechanism such as an electric motor and proper gearing will, of course, be provided to drive the drum 15 at the speed required to accomplish the operation described with proper regard to the size and spacing of the angle bars 12 and the speed and capacity of the measuring belt.

The measuring belt 2 is composed of equally spaced cross bars or slats 20 having their opposite ends secured to spaced chains 21. These chains are carried by an idler drum 22, mounted in the upper portion of the storage bin 1, and a driven drum 23 mounted just above the discharge outlet 18 in the bottom of the bin. Suitable mechanism will be provided to drive the drum 23 at a speed sufficient to move the slats 20 rapidly through the body of powdered material to keep it in a state of live suspension so that it will be of uniform and constant density throughout the zone of movement of belt 2. As shown in Fig. 4, drum 23 extends from side to side of the bin to seal the powder containing portion thereof from the discharge outlet except for the narrow curved passage around its periphery through which belt 2 moves.

Not only does the belt act as an agitator for the stored material but the equally spaced bars 20 constitute barriers defining measuring chambers therebetween of equal size. These measuring chambers are filled with constant density powdered material as the belt passes through the upper portion of the storage bin, and as the slats move down closely adjacent to the bin wall, as shown in Figs. 3 and 5, the measuring spaces are completely closed between the drum 23 and such wall. In this way successive increments, portions, or parcels of powdered material of equal volume are moved from the main body of the material in the storage bin to the discharge outlet 18. Because of the bending of the belt beneath the drum 23 and outer edges of adjacent slats are spread slightly apart to free the powdered material trapped therebetween. It will be evident that since the material is kept in uniform density suspension and is moved to the outlet in increments of equal volume, a definite known weight of powdered material, directly proportional to the number of increments, may readily be delivered. Depending on the time interval during which it is desired to have such a known quantity of material dispensed the speed of the belt 2 may be established for bars of a certain width and spaced a certain distance apart. In order to weigh batches of material within slight differences the measuring chambers should be quite small. The speed of the measuring belt may be regulated to change the rate of material delivered and automatic mechanism may be provided to start and stop the belt as required to dispense batches of any weight. To prevent powdered material packing between drum 23 and the measuring belt, thus causing the slats 20 to scrape heavily against the wall 1, and enabling additional powdered material to be packed into the measuring spaces, scrapers 24 are provided in the entering angle between the drum and belt to scrape all powdered material from the drum periphery.

An alternative construction is shown in Fig. 5 in which the belt speed may be adjusted in the

same manner to move powdered material to the discharge outlet at a given rate. With this mechanism, however, the belt 2 will be in continuous motion and will not be started to begin delivery of a batch and stopped to complete such delivery. Instead a closure member will be provided to cover the opening 18 when delivery of powdered material is not desired. For illustrative purposes this closure member is shown as a curved sliding door 25 which may move from the open, solid line position shown in Fig. 5, to the closed position shown in broken lines in which the flow of powdered material is interdicted. Various types of closures may be employed for this purpose, such as a single hinged door, or two drop doors hinged one along each edge of the opening 18 to swing from a depending position upward toward each other into closed overlapping position. When any such door is closed the powdered material carried downward along the right wall of the storage bin as shown in Fig. 5 will be raked across the outlet 18 and carried up along the left wall of the storage bin back into the main storage chamber. As soon as the door 25 is moved to open position, however, powdered material will be delivered therethrough at a constant rate until the door is again closed. Whether an intermittent drive for drum 23 and a freely open outlet 18, or a continuous drum drive in conjunction with an outlet closure member 25, is employed, no powdered material will be able to pass downward to the discharge opening between the left wall of the storage bin 1, as shown in Figs. 3 and 5, and the drum because the slats 20 continuously move upward through this space.

If the powdered material has a tendency to pack or clot, fluffer mechanism such as shown in Figs. 3, 4 and 5 may be employed to break up any clots in such material and to fluff it immediately after it passes through the discharge outlet 18. Such mechanism is housed in a casing 3 attached to the bottom of the storage bin 1 and covering the discharge outlet. At each side of this casing, preferably in a recess (see Fig. 4), is mounted a pair of sprockets 30. Striking elements, such as wires 31, which should be stretched under tension, extend between and are secured to corresponding sprockets of the opposite pairs. These striking wires are driven through the falling sheet of powdered material to strike against the particles thereof. While the wires may move generally upward or downward or even transversely of the material sheet, I prefer that the sprockets turn in the direction of the arrows in Figs. 3 and 5 so that the wires move through the powdered material generally in its direction of fall. The speed of the wires, in order to strike the material sharply in such case, must be considerably in excess of the falling speed of the powdered material, but the sheet will not be appreciably dispersed by the fluffing operation if the wires pass through it in this manner. On the contrary, where the sheet is composed of a progression of falling increments, it will leave this fluffer mechanism in almost a continuously uniform sheet. Air pipes 32, delivering air under small pressure, may be provided to slightly increase the falling speed of the powdered material over that which it would acquire from gravity, and to prevent powdered material dust collecting upon or blowing up into the casing 3 after it emerges into the air.

From the casing 3 the fluffed, powdered material will drop in a falling sheet through spout 33. Spray nozzles will be arranged adjacent to the casing for dispensing a spray of liquid against the powdered material sheet to mix therewith. As has been disclosed heretofore in describing my process, the number and arrangement of the nozzles may be varied within wide limits, examples of typical arrangements being shown in Figs. 2, 3, 5 and 6 to 14, inclusive, each adapted best to produce a mixture stream with special characteristics. Preferably the nozzles 4, as shown in Figs. 1 and 2, are adjustable for positioning in any one of various positions and attitudes. They are carried by a conduit having a swivel joint 40 rotatable to adjust the angle of the nozzles to the falling powdered material sheet. The supply pipe for this conduit is also swiveled upon a joint 41 so that not only may the angle of the nozzles be adjusted, but their distances from the sheet of powdered material, and to some extent their height, may be varied. Further vertical movement is permitted by mounting the liquid supply pipe upon a bracket 42 which can be raised or lowered. This bracket may be slotted lengthwise, as shown in Fig. 2, so that it can be clamped in the desired vertical position by a bolt extending through such slot. Universal adjustment is thus provided so that the nozzles 4 can be fixed in any desired relation to the powdered material sheet.

The flask F will be carried beneath the dispenser by suitable mechanism illustrated diagrammatically in Figs. 1 and 2. Automatic control devices may be disposed for contact with the flask for starting and stopping the delivery of powdered material and liquid so that the mixture delivery will commence when the flask begins to move beneath the dispensing mechanism and the flow of mixture will be stopped as the flask moves out from beneath such mechanism. Various elements discussed heretofore will be adjusted so that the desired amount of material will be deposited uniformly over the entire area of the flask as it passes beneath the dispenser. Depending on the distance between the flask and the dispenser, and also upon the position and arrangement of the nozzles 4, a replaceable spout 43 of the proper length may be attached to the bottom of the casing 3, through which the sheet of powdered material falls.

Fig. 16 illustrates mechanism for producing gypsum base molds for use in making metal castings by a continuous process which incorporates my mixture dispensing equipment. In this device F incorporating matchplate with patterns thereon are secured to a belt 5 which makes a complete circuit in the direction indicated. This belt will be driven intermittently, and its movement will be controlled automatically by operation of the various molding mechanism. After an extractor 50 has withdrawn a finished mold M from a flask while the belt 5 is stopped, it will move a sufficient distance to bring the next mold containing flask into extracting position. Meanwhile the empty flask has been moved into the next position where, during the time required for extracting the succeeding mold, an air or water spray 51 will blow out all dirt and plaster particles.

When the next mold has been withdrawn from its flask the belt 5 again moves to bring still another flask into registery with the extractor. The first flask will then be in position to receive a spray of separator liquid from pipe 52 upon the matchplate. With the flask inverted all excess liquid will drip out leaving only a separating film clinging to the matchplate and patterns.

From that position the flask continues by intermittent movement into a right side up position where a treating liquid of any desired nature may be deposited in it by pipe **53**. During movement of the flask from this station to its next stopped position it will pass beneath the molding mixture dispensing mechanism heretofore described. If a laminated mold is to be made by the technique illustrated in Fig. 15, several successive dispensing stations will be incorporated in the mechanism of Fig. 16.

In the mold extraction period between successive dispensing operations, during which the flask is stationary, the last layer deposited will have an opportunity to set somewhat before the following layer is laid. After being filled the flask continues by the same intermittent movement through the setting table **54** which is preferably maintained in a heated condition to expedite setting of the mold material and to facilitate extraction of the mold from the flask. Before the flask is tilted in its circuit the molding material will have lost its fluidity. Eventually the flask will again be brought into registry with the extractor **59** by which time the mold material will be set sufficiently so that the mold can be withdrawn from the flask and placed upon belt **55** for transmission to drying mechanism. The flask will then be ready to begin a new molding cycle as described.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The process of making a gypsum base mold, which comprises delivering a measured quantity of powdered gypsum base material in a downwardly moving sheet of substantially uniform thickness and density, entraining such powdered material in a spray of mixing liquid, thereby intimately commingling the powdered gypsum base material and the mixing liquid into a substantially homogeneous fluid mixture, and dynamically depositing such fluid mixture in a flask and matchplate assembly, and intimately about a pattern on such matchplate.

2. The process of making a gypsum base mold, which comprises dropping a measured quantity of powdered gypsum base material in a freely falling sheet of substantially uniform thickness and density, during such descent striking the particles of freely falling powdered material without appreciably deflecting it from its path of descent, and thereby breaking up any clots in such powdered material and fluffing it, thereafter entraining the fluffed material in a spray of a definite quantity of mixing water, thereby intimately commingling the powdered gypsum base material and the mixing water into a substantially homogeneous fluid mixture, and dynamically depositing such fluid mixture in a flask and matchplate assembly, and intimately about a pattern on such matchplate.

3. Dispensing mechanism, comprising means for delivering powdered material in a sheet freely falling substantially vertically downward and of substantially uniform thickness and density, and a plurality of nozzles adjacent to said means, each delivering a fan-shaped sheet spray, arranged in line for overlapping of their sheet sprays in coplanar fashion, the plane of the nozzle sprays being directed downwardly toward the sheet of freely falling material to meet such sheet at an acute angle and along a substantially horizontal line, thereby deflecting the powdered material from substantially vertical downward movement and entraining such material in the liquid sheet spray, and intimately commingling the powdered material and liquid into a substantially homogeneous fluid mixture.

4. Dispensing mechanism, comprising means for delivering powdered material in a sheet freely falling substantially vertically downward and of substantially uniform thickness and density, and nozzles disposed on opposite sides of such sheet of freely falling material adjacent to said means, one on each side of the falling material sheet having its axis directed downwardly toward such sheet, and operable to deliver a sheet spray of liquid against the powdered material sheet at an acute angle thereto, thereby dissipating the sheet of powdered material and intimately commingling it with the liquid into a substantially homogeneous fluid mixture.

5. Dispensing mechanism, comprising means for delivering powdered material in a sheet freely falling substantially vertically downward and of substantially uniform thickness and density, and a nozzle adjacent to said means, having its axis directed downwardly toward the sheet of freely falling powdered material and operable to deliver a sheet spray of liquid against the powdered material sheet at an acute angle thereto, and a second nozzle also disposed adjacent to said means and having its axis directed downwardly toward the sheet of freely falling material, and operable to deliver a sheet spray of liquid toward the powdered material sheet at an acute angle thereto and in a plane beneath the plane of the spray sheet emitted by said first nozzle, thereby entraining the powdered material first in the sheet spray of said first nozzle and thereafter striking the fluid mixture thus formed with the sheet spray from said second nozzle.

6. Dispensing mechanism for powdered material, comprising a storage bin, a measuring belt including a succession of barriers spaced apart equally to constitute therebetween measuring chambers of equal volume, means for moving said barriers from said storage bin to and past a discharge outlet for successive discharge therethrough of increments of powdered material conveyed between successive barriers from said storage bin, to drop downward in a sheet of substantially uniform thickness and density, and a nozzle adjacent to such discharge outlet, having its axis directed downwardly toward the sheet of powdered material, and operable to project a sheet spray of liquid against the powdered material sheet at an acute angle thereto, thereby intimately commingling the powdered material and liquid into a substantially homogeneous mixture.

7. Dispensing mechanism for powdered gypsum base material, comprising a storage bin, a measuring belt including a succession of barriers spaced apart equally to constitute therebetween measuring chambers of equal volume, means for moving said barriers from said storage bin to and past a discharge outlet directly above a matchplate having a pattern thereon, for successive discharge through such outlet of increments of powdered material conveyed between successive barriers from said storage bin, to fall freely substantially vertically downward in a sheet of substantially uniform thickness and density, and a nozzle directed downwardly to deliver a liquid spray against such freely falling material sheet for intimate mixing therewith, said spray having sufficient velocity to dynamically deposit upon the

matchplate and about the pattern thereon the fluid mixture formed by such liquid spray and powdered material.

8. Dispensing mechanism for powdered gypsum base material, comprising a storage bin having a discharge outlet directly above a matchplate having a pattern thereon, a measuring belt disposed in said storage bin, and including a plurality of slats disposed transversely of its direction of movement and spaced apart equally to constitute therebetween measuring chambers of equal volume, means for driving said belt rapidly through the body of material in said storage bin and past its discharge outlet, thereby to maintain such body in a state of live, uniform density suspension and to convey material between said slats in successive increments of equal weight to the discharge outlet for successive discharge therethrough, to fall freely substantially vertically downward in a sheet of substantially uniform thickness and density, a nozzle adjacent to the storage bin discharge outlet and having its axis directed downwardly toward the sheet of freely falling material, and operable to deliver a sheet spray of liquid against the powdered material sheet at an acute angle thereto, thereby deflecting the powdered material from substantially vertical downward movement and entraining such material in the liquid spray sheet, and intimately commingling the powdered material and liquid into a substantially homogeneous fluid mixture, said sheet spray having sufficient velocity to dynamically deposit upon the matchplate and about the pattern thereon the fluid mixture formed by such spray and powdered material.

9. Dispensing mechanism for powdered material comprising a storage bin, a measuring belt including a succession of barriers spaced apart equally to constitute therebetween measuring chambers of equal volume, means for moving said barriers from said storage bin to and past a discharge outlet for successive discharge therethrough of increments of powdered material conveyed between successive barriers from said storage bin, to fall freely substantially vertically downward in a sheet, fluffer mechanism including a plurality of striking elements, means operable to drive said striking elements through the sheet of freely falling material for impacting the particles thereof, thereby to break up any clots in such material and to fluff it, and a nozzle adjacent to said fluffer mechanism and having its axis directed downwardly toward the sheet of freely falling powdered material, and operable to deliver a sheet spray of liquid against the powdered material sheet at an acute angle thereto, thereby deflecting the powdered material from substantially vertical downward movement and entraining such material in the liquid spray sheet, and intimately commingling the powdered material and liquid into a substantially homogeneous mixture.

10. Dispensing mechanism for powdered gypsum base material, comprising a storage bin, a measuring belt including a succession of barriers spaced apart equally to constitute therebetween measuring chambers of equal volume, means for moving said barriers from said storage bin to and past a discharge outlet directly above a matchplate having a pattern thereon, for successive discharge through such outlet of increments of powdered material conveyed between successive barriers from said storage bin, to fall freely substantially vertically downward in a sheet of substantially uniform thickness and density, fluffer mechanism including a plurality of striking elements, means operable to drive said striking elements through the sheet of freely falling material for impacting the particles thereof, thereby to break up any clots in such material and to fluff it, and a nozzle adjacent to said fluffer mechanism and having its axis directed downwardly to deliver a liquid spray against such sheet of freely falling powdered material for intimate mixing therewith, said spray having sufficient velocity to dynamically deposit upon the matchplate and about the pattern thereon the fluid mixture formed by such spray and powdered material.

11. Dispensing mechanism, comprising means for moving an assembly including a flask rim, a matchplate, and a pattern on such matchplate, in a horizontal direction, means for delivering powdered material in a downwardly moving sheet disposed above the path of movement of said assembly, a nozzle directed downwardly to project a liquid spray against such sheet of powdered material for intimate mixing therewith to form a fluid mixture, means controlling said delivery means and said nozzle for depositing a coating of the mixture of powdered material and liquid upon the matchplate and pattern of such assembly, a second means for delivering powdered material in a downwardly moving sheet also disposed above the path of movement of such assembly and in advance of said first delivery means, and a second nozzle directed downwardly to project a liquid spray against the sheet of powdered material delivered by said second delivery means for intimate mixing therewith, to deposit over the coating such second mixture of powdered material and liquid, thereby to produce a laminated mold structure.

12. A process of depositing a fluid mixture of powder and liquid ingredients in a receptacle comprising delivering a quantity of powdered material in a freely falling downwardly moving sheet, said sheet being considerably longer in length than width, and a liquid stream impinging against such sheet having sufficient velocity to form an intricate mixture of such liquid and powdered material and delivering said mixture into said receptacle with appreciable force.

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