

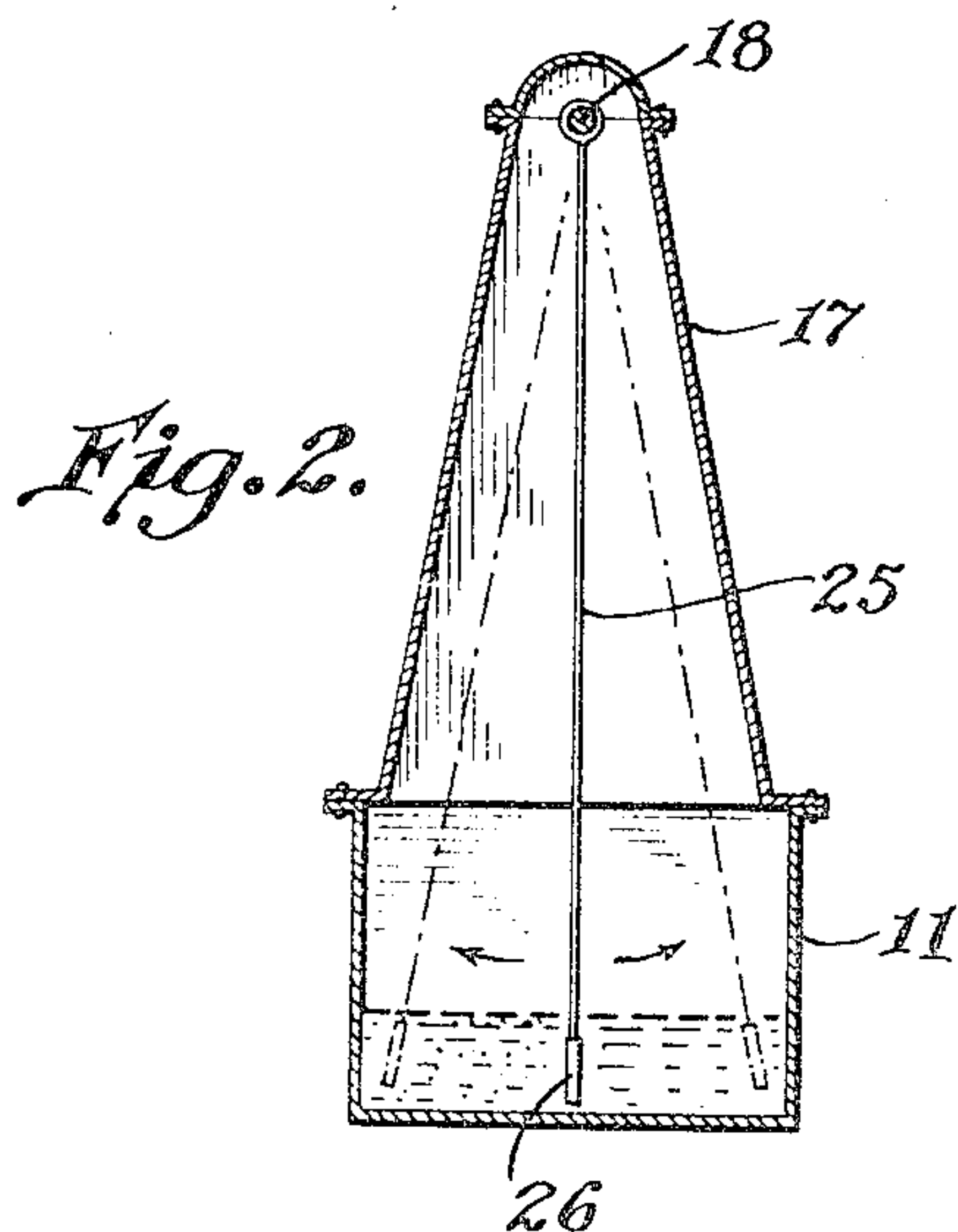
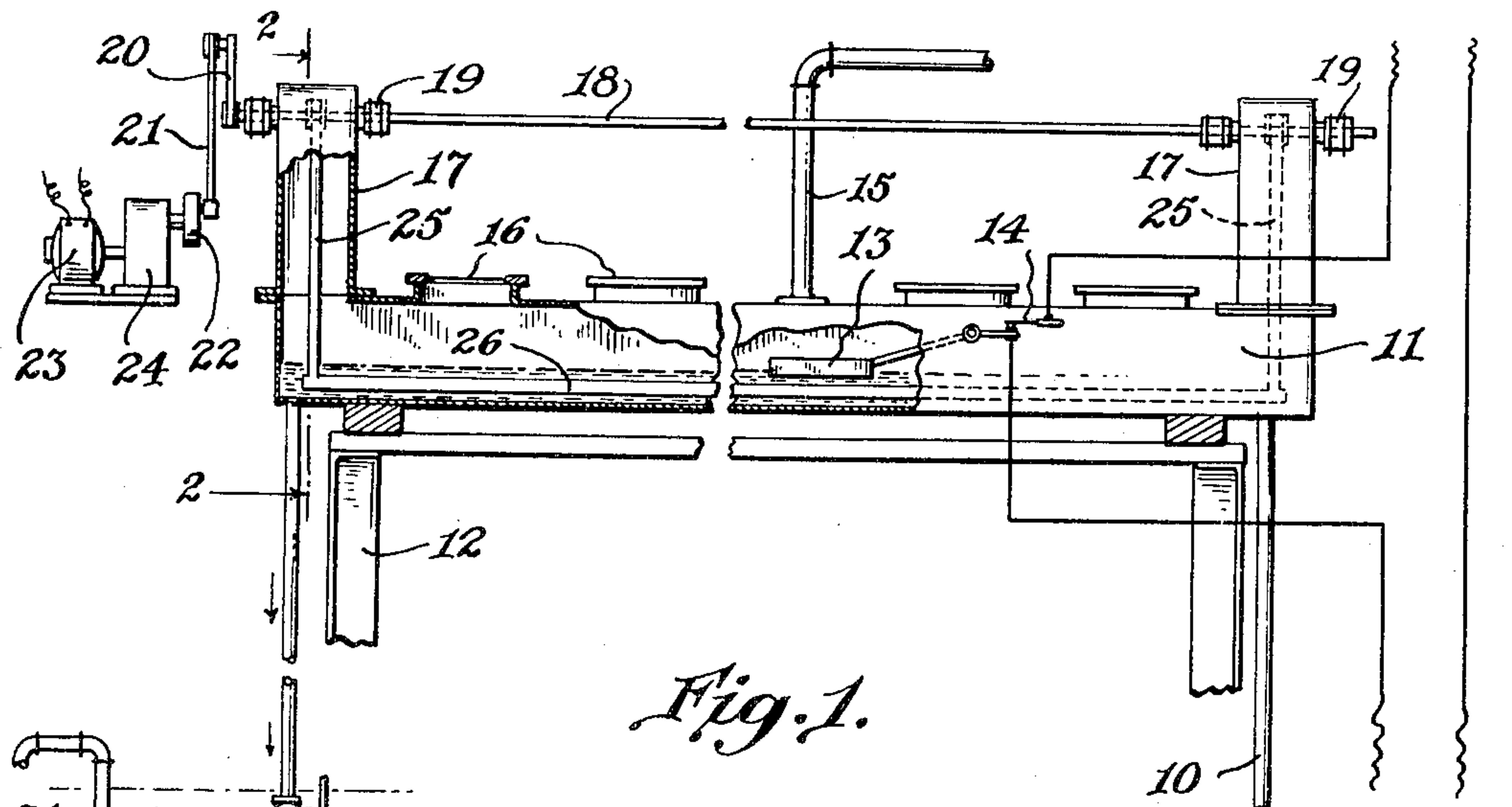
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METHOD OF AND APPARATUS FOR DEAIRING SLIPS

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METHOD OF AND APPARATUS FOR  
DEAIRING SLIPS

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The invention relates to improvements in the treatment of slip to be used in the casting of ceramic articles in plaster-of-Paris molds or other molds of porous material, and particularly to the de-airing of the slip while it is en route from the storage tank to the molds.

Slip is prepared from clay, with various ingredients, and it has long been known that air, in considerable quantity, is embodied in the slip in the form of minute bubbles. The harmful effect of the air in the slip on the finished product has also long been known, and various efforts have been made heretofore to remove the air and thereby improve the product. However, as far as is known, no one has ever disclosed heretofore any method or apparatus similar to the present invention, in which the slip while passing from the storage tank to the casting molds is spread in a shallow layer or pool, and while being gently stirred or agitated, beneath the surface, is subjected to a vacuum to remove the air or other gases which rise to the surface.

One of the objects of the invention is to provide a new and improved method and apparatus by which there is a continuous operation of de-airing the slip, so that when the slip leaves the storage tank it flows through the de-airing chamber to the plaster-of-Paris casting molds without any opportunity for the accumulation of air after leaving the de-airing chamber.

Another object of the invention is to improve the de-airing operation by spreading the liquid slip in a shallow pool or stream having an expansive surface, so that the air bubbles or other gases will more readily and rapidly rise to the surface subjected to the vacuum in the de-airing chamber.

Another object of the invention is to further improve the de-airing operation by gently stirring the shallow stream or pool of liquid slip, beneath the surface thereof, to thereby drive the bubbles to the surface and to prevent the formation of scum on the surface.

A further object of the invention is to prevent the liquid slip, in its flow from the de-airing chamber to the porous casting molds, from becoming exposed to air.

Still another object of the invention is to prevent any entrapment of air in the de-aired slip by keeping the pump which delivers the liquid slip to the molds, under a pressure head of slip, so that the pump is filled and under pressure even when the pump is not operating.

Another object of the invention is to prevent any discharge of the slip when the pump is not

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operating, which is accomplished by extending the discharge pipe upwardly to a point at a higher level than the gravity head less the suction head.

Various other objects of the invention will be apparent to those skilled in the art, from the following detailed description in connection with the accompanying drawings, in which

Figure 1 is an elevational view of the apparatus, with parts broken away, and

Figure 2 is a vertical sectional view of the de-airing or vacuum chamber, taken on line 2—2 of Figure 1.

The slip is prepared in the usual manner and after treatment in the blunger it is screened and then delivered to the upper end of an ordinary storage tank 1, as by a pipe 2. This tank, which is usually large enough to hold several days' supply of slip, is shown in the drawing as broken away at the center so that it can be of any desired size. The tank is preferably provided with the usual agitating elements 3 carried by a shaft 4 which is connected by bevel gears 5 to a motor 6, by which the shaft is continuously rotated, as is well known in the art.

In accordance with the present invention the de-airing of the slip is a continuous operation; the liquid slip in the storage tank being delivered continuously to a de-airing or vacuum chamber, through which it flows while being gently stirred or agitated, and being continuously delivered from the de-airing chamber to plaster-of-Paris molds or other molds of porous material.

In the form illustrated, a pump 7, operated by a motor 8, draws the slip from the bottom of the storage tank 1 through a pipe 9 and delivers it through a pipe 10 to the bottom of a de-airing or vacuum chamber 11, preferably at a point adjacent one end thereof. The chamber is supported in an elevated position on a frame 12.

This de-airing chamber is air-tight throughout and may be of any desirable shape, but in the particular form shown it is of considerable length and thus there is presented an expansive surface of the slip, so that there will be ample time to de-air the slip as it flows from the entrance end of the chamber to the discharge end thereof.

The slip is continuously delivered to one end of the de-airing chamber, and continuously discharged from the opposite end thereof to the casting molds, as previously mentioned, and in accordance with the present invention it is very desirable that the pool or stream of liquid slip be rather shallow, so that it can be more quickly and more thoroughly de-aired. Of course, the



invention is in no manner limited to any particular depth, and it may be varied within wide limits in different circumstances, but a good depth is around one and one-half inches.

If the slip should be delivered to the molds in less volume than it is delivered to the de-airing chamber the slip would rise in the chamber, so that the pool or stream might reach a greater depth than desirable. In order to maintain a shallow stream at a substantially constant level, means preferably is provided for temporarily stopping the pump 8 if the surface of the slip rises above a desired level. For this purpose the chamber is preferably provided with a float member 13 so arranged that if the slip rises above a desired level it will open a switch 14 and thereby stop the motor 8 which drives the pump 7. Of course, the pumping operation will be resumed as soon as the slip falls to the desired level and the float thereby causes the switch to be closed. Float controlled switches are so well known that a detailed illustration and description are unnecessary.

The slip de-airing chamber is maintained at the desired degree of vacuum by any preferred means, and numeral 15 refers to a vacuum line having one end connected to the de-airing chamber and the other end leading to a vacuum pump (not shown) or to any other desired source of vacuum. The de-airing chamber is also preferably provided with a number of peep holes 16, so that the condition of the slip in the chamber can be readily determined.

In accordance with the method and apparatus disclosed herein, it is desirable to gently stir or agitate the slip, beneath the surface, in its course from the receiving end to the discharge end of the de-airing chamber, as previously mentioned. Of course, various means may be employed for this purpose, but in the form illustrated, hollow columns 17 project upwardly from the opposite ends of the de-airing chamber 11, and as these columns communicate with the interior of the chamber they are constantly under vacuum. A shaft 18 is mounted for oscillation in the upper ends of these columns, and air-tight bushings 19 are provided to prevent leakage of air into the chamber. The shaft 18 is constantly oscillated by any desired means. In the form shown, a crank arm 20 is attached to the end of shaft 18, and a connecting rod 21 has one end connected to the crank arm and the other end eccentrically connected to a disc 22 which is continuously rotated by a motor 23 through speed reduction gearing 24.

The shaft 18 carries depending arms 25 which are attached at their lower ends to a stirring or agitating member 26, which is shown in the form of a bar, but may be of any desired form.

The arc of swing of the agitating member is preferably such that it always remains under the surface of the slip, as shown in Figure 2. The movement of the agitating member back and forth gently stirs the slip as it travels from one end of the chamber to the other, so that the air bubbles rise to the surface. In accordance with the invention there is an expansive surface, and the stream or pool is shallow, so that the slip is thoroughly and rapidly de-aired before it reaches the discharge end of the chamber. And as the agitating member is moving back and forth only a short distance below the slip surface, its action is such that it also performs the very important function of preventing the accumulation of scum on the surface.

The de-aired slip is now ready for delivery to the casting molds, and, of course, it is important that no air bubbles be picked up by the slip in its passage to the molds. The preferred means by which the slip is delivered from the de-airing chamber to the casting molds, without exposure to the accumulation of air, will now be described.

A pipe 27 leads downwardly from the bottom of the discharge end of the de-airing chamber, and this pipe connects with the inlet end of a diaphragm pump 28. Another pipe 29 leads from the discharge side of the pump to any desired means for introducing the slip into the plaster-of-Paris molds.

As diaphragm pumps are well known, it is unnecessary to illustrate or describe the pump in detail; it being sufficient to point out that check valves 30 and 31 are provided at the inlet and discharge ends, respectively, and a pipe 32 leads from a source of air pressure to operate the diaphragm. A shut-off valve 33 may be provided in the pipe 27.

By reference to Figure 1 it will be noted that the de-airing chamber 11 is above the pump 28. The vertical distance between the chamber and the pump is such that the pump is always under a pressure head. In other words, there is a vacuum head in the pipe 27, due to the vacuum in the de-airing chamber, and for the purpose of illustration it is assumed that the vacuum head extends down to the horizontal dash line shown in the lower left hand corner of Figure 1. Now by locating the pump below the vacuum head, i. e., below the dash line of Figure 1, there is always a pressure head on the pump, with the result that the pump is always full of slip and always under pressure, even when the pump is not operating. Thus it is apparent that no air will be entrapped in the pump to possibly contaminate the de-aired slip.

It is also desirable that there be no flow of the slip to the casting molds when the pump is not operating. For this purpose the pipe 29 from the delivery side of the pump extends upwardly a short distance above the dash line representing the vacuum head in Figure 1. That is, the pipe 29 extends to a point higher than the gravity head less the vacuum head, and hence the slip will flow through the pump 28 and pipe 29 up to, but not beyond, the dash line representing the vacuum head, so that no slip will be discharged from the pipe 29 unless the pump is operating.

It should also be mentioned that the present invention is also useful in hand delivery, for means can be provided for drawing off the slip as desired at any point in the discharge line from the de-airing chamber, where the gravity head is greater than the vacuum head.

It is thought that the manner in which the method is carried out, and the operation of the apparatus, will be clearly understood from the foregoing description, but a brief summary may be desirable. The prepared slip is delivered to the storage tank which is preferably of sufficient size to hold several days' supply, and while in the tank the slip is preferably agitated by continuously rotating elements 3.

The slip is pumped from the storage tank to the de-airing chamber, which is under constant vacuum, and at the same time slip is withdrawn from the de-airing chamber for delivery to the casting molds, so that the process is a continuous one; the slip being de-aired while



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it is on its way to the molds. The slip is preferably maintained in a shallow pool or stream in its flow from the entrance end to the discharge end of the de-airing chamber, so that the air bubbles will more easily reach the surface. In order to maintain the slip at the desired shallow depth, in case the slip is not drawn off as fast as it is delivered to the chamber, there is preferably provided a float-controlled switch to temporarily stop the pump 8.

While the slip is flowing from the entrance end to the discharge end of the de-airing chamber it is gently agitated or stirred to cause the air bubbles to rise to the surface, and this stirring operation is preferably entirely below the surface of the flowing stream, whereby the accumulation of scum on the surface is prevented.

This method of continuously de-airing the slip in its passage to the molds is very efficient and very rapid, and while the invention is in no manner limited to any particular means for stirring the slip while in the chamber, or to any particular form of chamber, yet I prefer one of oblong shape. The length of the chamber may vary greatly in different installations, depending upon various factors, but in ordinary circumstances a length in the neighborhood of twelve feet is more than ample to assure complete de-airing. It will at once be apparent to those skilled in the art, that with such an expansive surface under vacuum and with a shallow stream being constantly stirred, the de-airing process will be performed with great rapidity and thoroughness.

The de-aired slip is constantly withdrawn from the chamber and delivered to the casting molds, preferably by pump. This pump is located at a vertical distance below the chamber greater than the vacuum head, so that the pump is always filled and under a pressure head, even when the pump is not operating, and hence there is no chance of entrapment of air. And, as previously mentioned, the delivery pipe from the pump preferably extends upwardly a distance greater than the gravity head less the vacuum head, so that there will be no discharge of slip when the pump is not operating.

Having fully described the invention, what I claim is:

1. Apparatus for de-airing slip including a vacuum chamber adapted to contain liquid slip, a pump for delivering the slip from the vacuum chamber to molds in which the slip is to be cast into ceramic articles, and said vacuum chamber being at a greater distance above the pump than the height of a column of slip which the vacuum in the chamber will support, whereby the pump is under a pressure head.

2. Apparatus for de-airing slip including a vacuum chamber adapted to contain liquid slip, a pump for drawing slip from the vacuum chamber, said vacuum chamber being at a greater distance above the pump than the height of a column of slip which the vacuum in the chamber will support, whereby the pump is always under a pressure head, and a pipe for delivering the slip from the discharge end of said pump to molds in which the slip is to be cast into ceramic articles, said pipe extending upwardly to a point greater than the difference between the gravity head and the vacuum head of the slip, whereby there will be no discharge of slip except when the pump is operating.

3. Apparatus for de-airing slip including a vacuum chamber, means for delivering slip to the

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vacuum chamber, means for stirring the slip in the vacuum chamber, a pump for delivering slip from the vacuum chamber to molds in which the slip is to be cast into ceramic articles, and said vacuum chamber being at a greater distance above the pump than the height of a column of slip which the vacuum in the chamber will support, whereby the pump is under a pressure head.

4. In the casting of ceramic articles in molds, the method of de-airing the liquid slip en route to the molds, which comprises continuously flowing a shallow stream of slip having an expansive surface through a chamber, gently stirring the stream as it flows through the chamber, and subjecting the expansive surface of the stream to vacuum during its flow through the chamber.

5. In the casting of ceramic articles in molds, the method of de-airing the liquid slip en route to the molds, which comprises continuously flowing a shallow stream of slip having an expansive surface through a chamber, gently stirring the stream below its surface as it flows through the chamber, and subjecting the expansive surface of the stream to vacuum during its flow through the chamber.

6. In the casting of ceramic articles in molds, the method of de-airing the liquid slip en route to the molds, which comprises continuously flowing a shallow stream of slip having an expansive surface through a chamber, gently stirring the stream close to but beneath the surface thereof as it flows through the chamber, and subjecting the expansive surface of the stream to vacuum during its flow through the chamber.

7. In the casting of ceramic articles in molds, the continuous method of de-airing the liquid slip while passing from a storage tank to casting molds, which comprises continuously flowing the liquid slip to a chamber, continuously flowing the slip in a shallow stream having an expansive surface through the chamber, gently stirring the stream as it flows through the chamber, subjecting the expansive surface of the stream to vacuum during its flow through the chamber, and continuously flowing the slip from the chamber to the casting molds without opportunity for the accumulation of air after leaving the de-airing chamber.

8. Apparatus for de-airing slip including a vacuum chamber, means for continuously flowing liquid slip through said chamber in a substantially horizontal plane, means for continuously withdrawing de-aired slip from the vacuum chamber and delivering it to casting molds, and means for gently stirring the slip while in the chamber, said stirring means being located within the slip and below the surface thereof.

9. Apparatus for de-airing slip including a vacuum chamber, means for continuously flowing liquid slip through said chamber in a substantially horizontal plane, means for continuously withdrawing de-aired slip from the vacuum chamber and delivering it to casting molds, and means for gently stirring the slip while in the chamber, said stirring means positioned within the slip and close to but below the surface thereof.

10. Apparatus for de-airing slip including a vacuum chamber, means for continuously flowing liquid slip through said chamber in a substantially horizontal plane, means for continuously withdrawing de-aired slip from the vacuum chamber and delivering it to casting molds, and means for gently stirring the slip while in the



chamber, said stirring means including an elongated rod-like member and means for moving the rod-like member back and forth beneath the surface of the liquid slip.

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