June 5, 1956 F. R. FORREST 2,748,666

METHOD FOR HANDLING HIGH CONSISTENCY PAPER PULP

Original Filed June 29, 1946

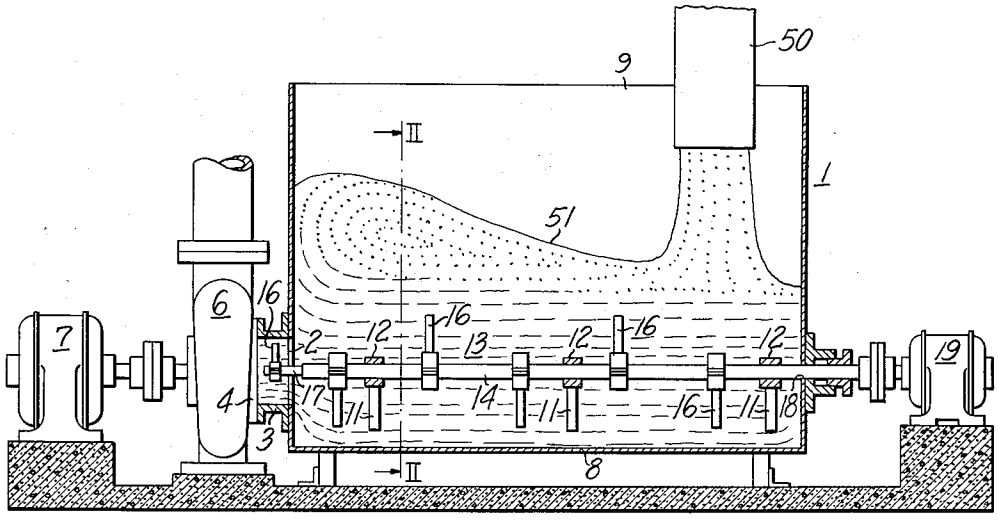


Fig. 1

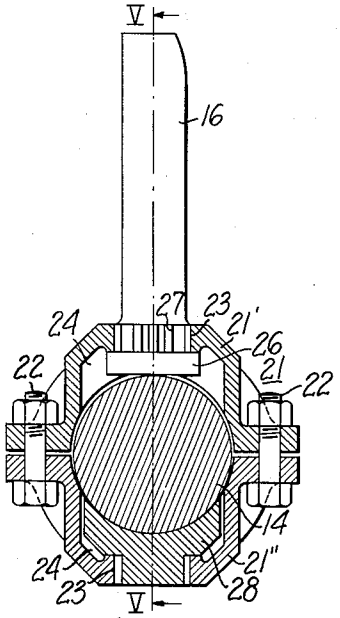


Fig. 3

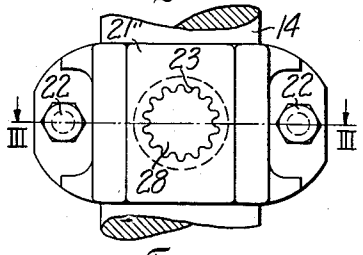


Fig. 4

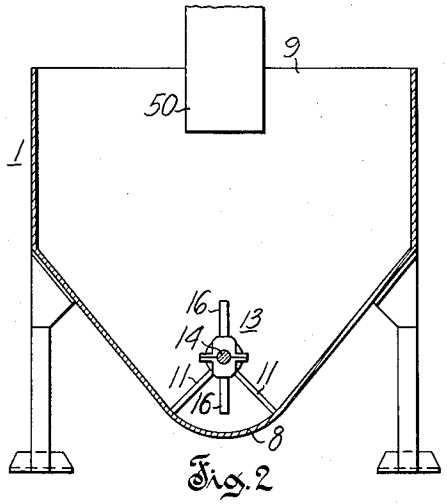


Fig. 2

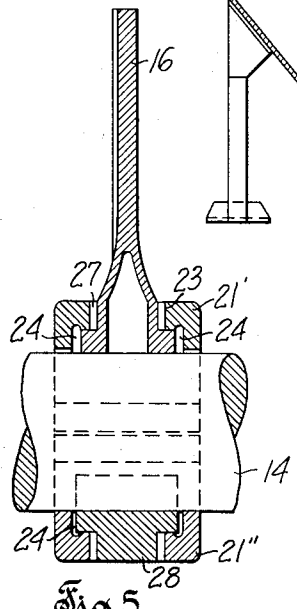


Fig. 5

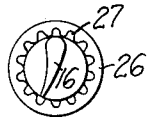


Fig. 6

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# METHOD FOR HANDLING HIGH CONSISTENCY PAPER PULP

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Continuation of abandoned application Serial No. 680,460, June 29, 1946. This application October 7, 1953, Serial No. 384,713

2 Claims. (Cl. 92—20)

This invention relates in general to a method of handling pulp used in the manufacture of paper and the like, and particularly pulp of high consistencies or high densities as sometimes referred to. This application is a continuation of my application Serial No. 680,460, filed June 29, 1946, now abandoned.

In the paper industry it is an advantage to be able, in pulp processing, to handle, store and pump from one location to another, pulps of a consistency of 5% solids or higher.

Prior to the present invention it had been generally accepted commercial practice for the most part to keep the pulps at consistencies of less than 5% during most of the processing steps in order that the pulps might be readily forwarded from one step to another. This has necessitated large storage chest facilities, thickening of the stock before sending to the various processing machines, and the handling of large quantities of excess water, resulting in inefficiencies of operation. In order to avoid these inefficiencies, attempts had previously been made, without appreciable success, to pump stock at consistencies greater than 5%.

The present invention is directed toward the provision of a means and method of efficiently transferring pulp stocks at consistencies upwards of 5% and up to 8% to 10%, or more, solids. Advantages gained are, for example, greater fiber storage capacities for chests of given dimensions, and ready transfer of high consistency stocks from the chests to beaters and refiners, chemical reaction tanks of bleach plants, etc.

An object of the invention is to provide an improved method for increasing the flowability of high consistency stocks and have a beneficial effect on the fiber.

Another object of the invention is concerned with maintaining free flow of high consistency stocks into the suction inlets of stock pumps by elimination of condition ordinarily causing air binding and bridging or blocking of the pump inlet.

A still further object is to provide improved apparatus for agitating pulps of high consistencies in a manner to facilitate their movement thorugh restricted openings.

A more particular feature of the invention consists in an arrangement with which the method of pumping high consistency paper pulp can be practiced in which a hopper or storage chest for pulp is provided with a discharge opening leading to a pump suction inlet, and a special high speed agitator is arranged in the hopper or chest, in alignment with the discharge opening, actuation of which will result in a general vibration and agitation of the body of pulp to be moved, coupled with a localized impelling of a stream of the pulp toward and through the discharge opening at the desired efficient discharge rate, with free recirculation of any excess of moved stock through the body of stock.

The invention having the above described and still further objects and advantages can best be carried into practical effect as described herein with reference to the



accompanying drawing, in which like reference characters indicate the same or similar parts throughout the several views.

Fig. 1 is a vertical longitudinal sectional view of apparatus with which the method disclosed herein can be utilized according to the invention comprising a pulp hopper, a centrifugal pump and an agitator feeder;

Fig. 2 is a cross section taken on the line II—II of Fig. 1;

Fig. 3 is an enlarged cross sectional view of an agitator impeller taken on the line III—III of Fig. 4;

Fig. 4 is a plan view of the impeller arrangement of Fig. 3 as viewed from below;

Fig. 5 is a fragmentary view showing the impeller assembly in section on the line V—V of Fig. 3; and

Fig. 6 is a detail end view of the impeller blade as viewed looking down on Fig. 5.

In the apparatus shown in Fig. 1, a hopper or chest 1, mounted on a suitable base, is provided with a lateral discharge opening 2 in one of its lateral walls. Discharge opening 2 is connected by a short lateral passage or conduit 3 with the suction inlet 4 of a pump 6, shown as a centrifugal stock pump of known type, driven by an electric motor 7.

The hopper 1 may, as shown in Figs. 1 and 2, have a lower or bottom portion 8 extending generally in a horizontal direction from the lateral opening 2. The bottom portion of the hopper may have a trough like formation as shown in the drawing. The bottom portion 8 is open upwardly over substantially its entire area to an upper hopper portion 9 having substantially vertical lateral walls.

In the bottom portion 8 of the hopper 1, bearing supports 11, suitably secured to the hopper structure, provided a series of aligned journal bearings 12, generally coaxial with the lateral discharge opening 2 of the hopper. An agitator 13 having a main shaft 14 journaled for rotation in bearings 12, is provided with axial flow turbine type propeller blades 16, axially spaced along, and extending in generaly radial relation to the main shaft 14. An end of the main shaft 14, which may, as shown, be an axially adjustable shaft extension 17, carries one of the blades 16 in discharge opening 2, preferably within the confines of passage or conduit 3. The other end of the main shaft 14 may be passed, in rotatable relation, through a suitably sealed opening 18 in the wall of the lower portion of hopper 1, and may be suitably attached to an electric motor 19, or other means for rotating the agitator 13.

An agitator assembly suitable for carrying out the purposes of the present invention may be constructed by assembling a series of single bladed propellers in axially spaced relation, each from all others, along the main shaft 14. Suitable propeller blade members 16 are detachably connected with the main shaft 14 by individual retainer members 21, shown as consisting of a a pair of identical halves 21' and 21'' constituting a segmented ring, the segments of which are joined by suitable bolts 22.

Halves 21' and 21'' of retainer member 21, are each provided with a splined radial hole 23. In the inner surface of retainer member halves 21' and 21'', a recess 24 adjoins the inner end of hole 23, providing lateral space between the halves 21' and 21'' and the peripheral surface of any cylindrical element which may be passed therethrough.

Impeller blade 16, retained in position in generally radial relationship to shaft 14, is formed with a main body or blade of high aspect ratio and turbine blade like cross section, having an enlarged base flange 26 of such form and dimensions as to lodge in the recess 24, when the

blade 16 is passed through the hole 23 from the inside of retainer half 21'. Base flange 26 has such form and dimensions as will prevent its being passed through the hole 23, and its thickness is such that it will be clamped between the inside surface surrounding hole 23 and the surface of shaft 14 on which the blade is to be assembled. The blade 16 may also be provided with a short splined cylindrical portion 27, the splines of which will mesh in axially slidable relation with the splines of hole 23 in a plurality of positions of angular adjustment about the axis of the blade.

As the propeller assemblies found preferable in agitator impellers according to the present invention are of the single radial blade type, in which no more than a single blade travels in a given plane of rotation, each individual blade assembly is preferably balanced by insertion of a suitably formed eccentric counterweight 28 so formed as to occupy the recess 24 and hole 23 of retainer half 21''. The eccentric mass of counterweight 28 is designed to exactly balance that of blade 16 when such blade and counterweight are securely held in position in driving relationship to shaft 14 by the retainer member 21.

It will be readily understood that blades 16 may be suitably adjusted as to their effective pitch by changing the angular relationship between the splined hole 23 and splined portion 27 of blades 16, and that the ingenious propeller construction affords a ready adaptability to inclusion in any rotary material agitating and impelling rotor. Since each propeller unit is individually statically and dynamically balanced, any desired number of such units may be employed to create an agitator or impeller rotor of any desired length and blade spacing, without creating problems in static and dynamic balance.

The embodiment of the present invention as illustrated in Figs. 1 and 2 is useful in transferring paper pulp stocks of very high consistencies such as 5%–10%, or higher, solid to liquid ratio. Such high consistency stock is placed in or delivered to the hopper 1 through a pipe 50 for storage, and is made available for immediate use by actuation of the agitator 13, which is driven at a high rate of speed, sufficient to cause the tips of blades 16 to travel at a velocity in the neighborhood of 75 feet per second or higher. The blades 16 of the agitator rotor 13 are adjusted to have a helical pitch such that the action of the blades will tend to cause the material in the bottom portion 8 of hopper 1 to be impelled axially of the shaft 14 in the direction of lateral opening 2. The entire body of pulp above the agitator 13, which is the portion of pulp indicated by dots in Fig. 1, being in direct communication with the portions of the pulp being acted upon by the blades 16, which is the portion of the pulp indicated by dash lines, will be continuously agitated by the rotation of the agitator rotor 13. The upper surface 51 of the body of pulp, which is exposed to the atmosphere, is referred to herein as the free surface of the pulp. There will be a vibration of the body of pulp (indicated by dots) similar in nature to sonic wave vibration, and the part of the pulp in the immediate locality of the shaft 14 (indicated by dash lines) will be so acted upon by the thrust of the blades 16 that a localized, more or less compact, columnar flow of pulp will occur in the vicinity of the shaft 14 in a direction toward the opening 2. The nature of vibrations and turbulence produced in the body of pulp (indicated by dots) by the action of rotor 13 will be such as to maintain the body of high consistency pulp in a state of greatly improved flowability as compared with unagitated stocks of the same consistency. The volume of flow of the localized stream created in the bottom portion 8 of the hopper 1 in the direction of opening 2 may be regulated by adjustment of the speed of motor 19 and/or the pitch of blades 16, so that the flow will equal or exceed the capacity of the pump 7 for pulps of the consistency being handled under the conditions prevailing. The condition of improved flowability existing in the tank by virtue of operation of the agitator rotor 13 will be continued in the portion of the pulp discharged through opening 2 by the agitator blade 16 shown as operating within the short passage 3 leading to the pump inlet. Operation of the rotor 13 at sufficiently high rates of speed, such as mentioned above, will cause high consistency pulp to be readily transferable by the pump 6. There will be no bridging nor clogging of the pump inlet 4 or the discharge opening 2, and no air binding such as might be caused by the accumulation and expansion of air bubbles in the pulp mixture at the pump inlet if the present invention were not employed.

The agitator rotor 13, being driven separately and independently of the pump 6, can continuously maintain the desired conditions of flow in the hopper 1 and conduit 3, regardless of the conditions at the pump. And feed to the pump will be maintained by the present invention, even against severe throttling conditions in the pump discharge.

The method of handling high consistency pulps, forming a part of the present invention, can be carried out without use of the specific apparatus described and illustrated herein. It is only necessary that a body of pulp to be transferred be immured in a container and that a continuous agitation of the pulp within the lower portion of the container be maintained, with the simultaneous creation of a well defined localized flow of slightly agitated pulp, flowing in a definite direction through a portion of such a body of pulp; and that there be a continuous removal of some of the pulp directly from such localized flow, without abrupt change of direction and condition of flow of the removed pulp, and with continued agitation of the removed stream of pulp immediately subsequent to detachment from the main body of pulp within the container; and that provision be made for free recirculation of the unremoved portion of the localized flow of pulp, through the remainder of the body of pulp in the container.

The use of single instead of double, triple or quadruple bladed propellers has been found in actual embodiments of the present invention to produce a more desirable effect than such multiple bladed propellers. And it is thought that this superiority of single blade propellers may result from the greater vibration caused by such propellers when rotating at high rates of speed, as compared with multiple blade propellers. Furthermore, it has been found, in an actual embodiment, that an axial spacing between the blades of about 16–20 inches is productive of the most efficient results with high consistency pulps, and that speeds of on the order of 1150 revolutions per minute and a rotor diameter of on the order of 15 inches are most satisfactory for the usual industrial installation.

Operation of an apparatus such as that disclosed herein, and the handling of heavy paper stocks according to this invention, have been found to have a beneficial refining effect on the stock handled. The refining effect is thought to be the result of interfiber attrition resulting from the characteristic vibration and agitation occurring in the stock rather than the result of any direct abrasion of fibers by direct contact with the agitator blades. Stocks handled by the method of this invention have been found to have very desirable paper making characteristics.

The method of handling paper stock disclosed herein is intended to include such modifications and equivalents as may readily occur to persons skilled in the art within the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A method of withdrawing pulp from a mass of pulp having a free surface exposed to the atmosphere comprising the steps of impelling beneath the free surface of the pulp a columnar stream of pulp in a horizontal direction, receiving the columnar stream of pulp in a conduit having an inlet positioned beneath the free surface of the pulp in coaxial alignment with the columnar stream, maintaining a suction pressure in the conduit, and continuously agitating the mass of pulp to effect gravity feed-

ing of pulp into the columnar stream between the ends of the columnar stream and the removal of pockets of air accumulated in the mass of pulp vertically through the free surface of the pulp.

2. A method of withdrawing pulp from a mass of pulp having a free surface exposed to the atmosphere comprising the steps of impelling beneath the free surface of the pulp a columnar stream of pulp in a horizontal direction, receiving the columnar stream of pulp in a conduit having an inlet positioned beneath the free surface of the pulp in coaxial alignment with the columnar stream, maintaining a suction pressure in the conduit, gravitally feeding pulp into the columnar stream between the ends of the columnar stream, and removing pockets of air accumulated in the mass of pulp vertically through the free surface of the pulp.



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