

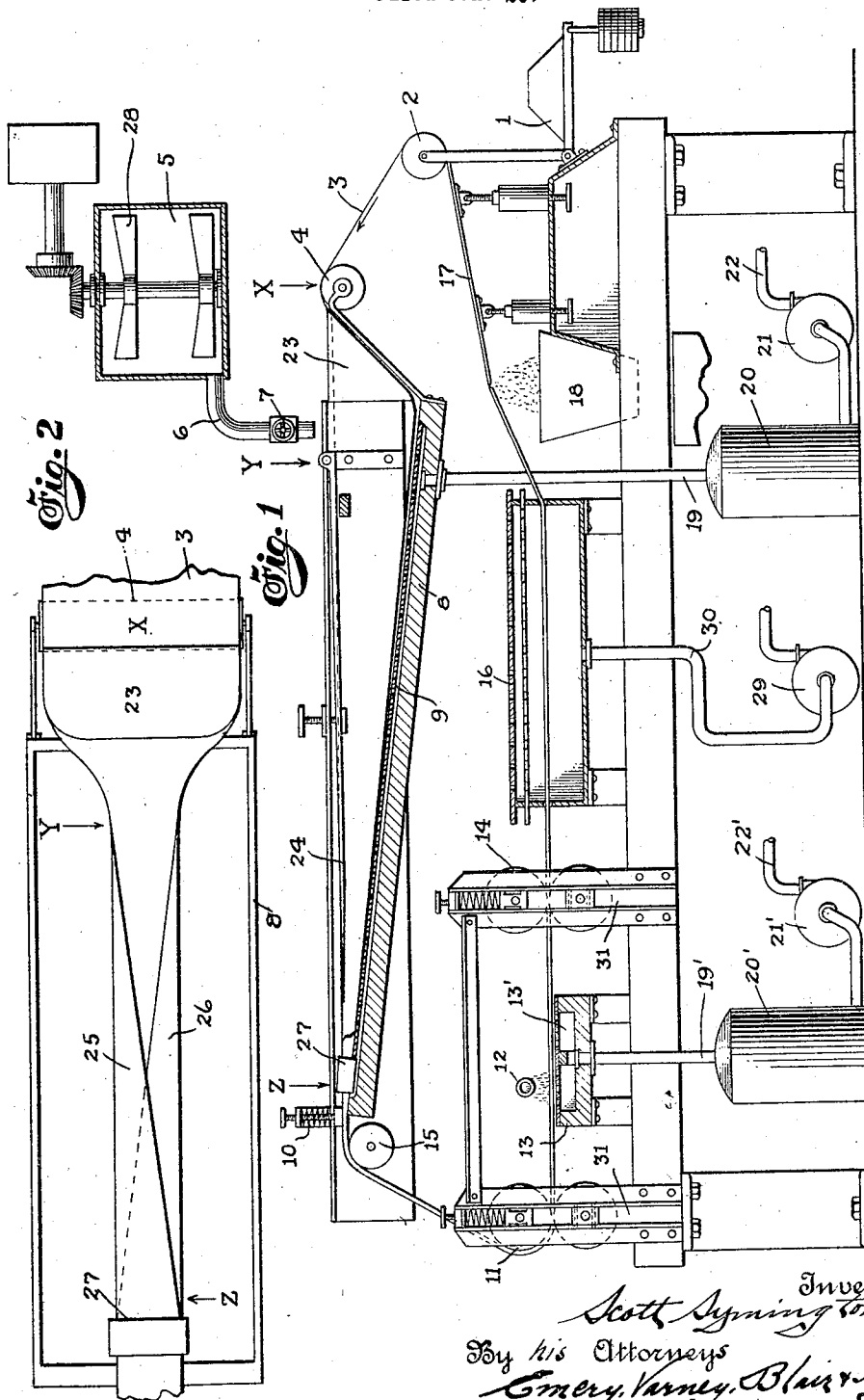
**Sept. 6, 1927.**

**1,641,708**

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## SEPARATION OF SOLIDS FROM LIQUIDS

Filed June 26, 1920



## UNITED STATES PATENT OFFICE.

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## SEPARATION OF SOLIDS FROM LIQUIDS.

Application filed June 26, 1920. Serial No. 391,863.

My invention relates to the separation of solids from liquids and has as an object the providing of an apparatus and a method whereby this result is accomplished in a substantially continuous, thorough and economical manner.

The methods employed, heretofore, for the separation of solids from liquids are attended by many disadvantages, such as lack of continuity, amount of labor required, losses due to handling, etc., and among the objects of my invention are the procurement of a material containing a smaller amount of liquid than heretofore in a substantially continuous manner, a reduction in the labor required and a diminution of loss due to handling.

In the accompanying drawing there is shown, diagrammatically, an illustrative and preferred form of apparatus embodying my invention and by means of which the method of my invention may be performed; and therein

Figure 1 is a side elevation, partly in section, of such apparatus; and

Figure 2 is a plan view of a portion of such apparatus.

In accordance with my invention the separation of solids from liquids may be carried out by delivering the mixture to be treated to a progressively advanced porous medium, continuously folding the solid within the medium whilst partially removing the liquid therefrom and subsequently treating in a continuous manner by pressing, washing, again pressing and drying. For the accomplishment of this separation there may be provided a porous septum 3 capable of progressive advancement in the direction indicated by the arrow, and preferably of endless form, which is led from a guide roll 2, to which is attached a tensioning device such as yielding means 1 which may, for example, comprise a weighted lever,—the function of said roll 2 and yielding means 1 being to maintain the septum under a tension so that said septum will be properly guided and the tendency to fold or wrinkle will be done away with, and the septum held firmly against the unfolding device—to a guide roll 4 and thence to the folding block 23, by means of which the folding of the septum is begun and the septum assumes a trough-like form.

The mixture under treatment may be de-

livered to the trough-like septum, as it leaves the folding block, from a container 5 which is, preferably, provided with an agitating device in order to present as uniform a mixture as possible to the porous septum. This container may be placed above the porous septum and the mixture allowed to run thereon, by gravity, or the container may be placed at any particularly advantageous point and the mixture transported to the septum by means of a pump. An arrangement for such a container with relation to the septum is that which is illustrated in the drawing; the container 5 being adapted with a means 28 for agitating the liquid, and having leading therefrom a pipe 6 for conveying the mixture from the container to the septum, the rate of flow being controlled by a valve 7.

From the folding block 23, the septum then passes over a surface 9 provided with apertures which surface may form, for example, the uppermost boundary of suction box 8. The surface 9 may conform to any desired shape, as for instance flat or slightly troughed.

During the passage over the surface 9, the greater amount of the liquid is removed, and in order to obtain a uniform layer of solid upon the septum which uniformity will serve to obviate difficulties due to banking up and a consequent clogging during subsequent operations, there may be provided a leveling or scraping means 24 as, for example, a portion of the folding arms cut and bent downward or a bar or plate suspended above the septum at the desired elevation. The septum during its advancement is folded by suitable folding means in order to enclose the collected solid. This folding may be brought about by a device, such as by the arms 25 and 26 (Fig. 2) which may be of any suitable structure as, for instance, arms one overlapping the other and possessing a considerable degree of resiliency. The resiliency of the folding arms may be inherent to the material of which the arms are constructed, or the material may possess not any inherent resiliency, the same being transmitted to the arms by suitably mounted spring members 10.

The folded body may then be drawn through the constricted passage 27 and thence over the guide roll 15 to a positive pressure device or directly to the pressing

means, which may comprise, for example, a set of cylindrical rolls arranged in suitable supporting members 31 and provided with means for adjusting the pressure exerted by said rolls. These pressing means exert upon the folded mass a positive pressing or wringing action thus causing a further separation of solid and liquid.

The material leaving, for instance, the press rolls 11 is, for many practical purposes, sufficiently free from mother liquor for utilization but in order to entirely free the solid from impurities contained in the mother liquor I may provide a washing means which, as illustrated, may comprise a pipe 12 arranged above a suction box 13, said pipe preferably being perforated in such a manner that the washing liquid may be sprayed upon the surface of the folded septum. The washing liquid adhering to the solid may then be partially removed by passing the septum-enclosed solid over a suction box 13' whereby liquid is displaced by air.

In order that the liquid remaining after the washing operation may be further removed from the solid there may be provided a pressing means such as press rolls 14, and a suitable drier, as, a drying box 16. The method of drying and the temperature employed, it will be realized, must be regulated in conformity with the properties of the product undergoing treatment, as for example, the drying box may be heated by the passage of a current of heated air, a gas, inert with respect to the product, or by steam coils or other heating means; and by means of reduced pressure within said drying box the heated gas may be caused to pass through the material at a higher rate thereby hastening the drying.

In order to open the septum and allow for the removal of the solid, I may provide an unfolding means 17 which may comprise a tongue or cone shaped member adapted to enter, raise and bend outward the upper and lower folds of the septum. The confining portions of the septum are thus removed whereupon the dry solid will, as a rule, detach itself without the application of any mechanical means. However, in order to obviate the possibility of any of the solid remaining attached to the septum I may provide a scraping means in conjunction with the unfolding member which will completely detach the solid from the carrying septum. The septum returns to the separating operation by means of rolls 2 and 4 and folding block 23. Immediately below the unfolding and scraping member there may be provided a hopper 18, or other mechanical device, serving to convey the solid to the containing receptacles. It will be noted that the above mentioned unfolding and scraping member engages at an acute angle against the septum, that is to say, the septum engages the

scraping edge in a line which lies at an acute angle to the plane of the unfold and scraper.

A diminution of pressure may be occasioned by the use of a standard evacuating device as, for instance, by employing a wet vacuum pump such as is illustrated at 21 and 21'. Pipes 19 and 19' lead directly to reservoirs 20 and 20', said reservoirs being in direct connection with the vacuum pumps 21 and 21' which force the liquor and enclosed air through the pipes 22 and 22' to the liquor storage or dispensing receptacles. In order to diminish the friction as the septum passes over the apertured surface I may substitute for said apertured surface any suitable equivalent means.

The pressure within the drying box 16 may be satisfactorily reduced by the utilization of a dry vacuum pump 29 connected to said drying box 16 by pipe 30.

It will be observed in accordance with the apparatus and method set forth that by delivering the mixture to a trough shaped septum which is progressively advanced over an apertured surface, thence enfolding the solid within the septum, and passing the septum-enclosed solid through a constricted channel, exerting a positive pressing influence thereon, washing, again pressing, drying, unfolding, and leading the septum back to the point at which the mixture is received, there is obtained an efficient separation of the solid from the liquid in a continuous cycle of operations.

The folding of the porous septum as it passes over the apertured surface is progressively accomplished, as it proceeds from the point indicated X to the point indicated Z on the drawings, in such a way that the flat septum at X is, by means of the folding block, folded into a rectangular trough-like shape upon reaching the point Y. From the point Y the folding is carried out continuously until point Z is reached, at which point the septum is completely folded and the solid entirely enfolded.

Furthermore, that part of my process embodying the folding of the septum in order to enclose the solid material and subsequent passage between cylindrical rolls for separation of solid from liquid may be carried out in connection with any of the methods in use heretofore in that the solid material, after having been freed as thoroughly as possible from the liquid by previous methods, may be delivered to the progressively advanced porous septum which is then folded so as to enclose the solid and passed through one or more sets of cylindrical rolls whereby the material is more completely dried.

In the passing of the porous septum over the apertured surface, the movement imparted to the septum may be continuous or intermittent, and this movement may be

transmitted to the septum by any suitable means as, for instance, by the pressure rolls, and to obviate difficulties due to unequal rates of rotation all such means may be geared together.

There is obtained in accordance with my method of separating solids from liquids an operation for such separation which is thorough and economical. It is economical by virtue of its being a substantially continuous process, since there is thereby obviated the losses attendant to many handlings and a great part of the attention previously required is eliminated hence reducing the cost for labor. The installation and construction are simple and the space occupied is relatively small both of which are factors of importance and, in consequence of the novel features embodied, I obtain a product sufficiently dry for immediate utilization.

The porous septum may be composed of a suitable textile such as a cotton or woolen fabric. For example, in the separating of mixtures which are neutral or but slightly acid or alkaline, it has been found that a good grade of cotton fabric is well adapted to bring about the separation; whereas in certain other operations, particularly those which have a fairly high acidity, it may be found particularly advantageous to use a woolen septum. It will also be apparent that the construction materials for the various other parts of my apparatus will be

so chosen as to be adapted to the type of work which it is desired to have the apparatus carry out.

It will, of course, be understood that the illustrative embodiment of my invention above described may be modified and varied within the scope of the subjoined claims.

I claim:

1. In an apparatus for the separation of solids from liquids, the combination with a porous septum, of means for imparting motion thereto, means for removing the liquid from the solid through said septum, means for washing the solid on the septum after the initial removal of the liquid therefrom, and means for removing the washing fluid from said solid.

2. In an apparatus for the separation of solids from liquids, the combination with an endless septum, of means for supplying the same with a saturated solid, means for folding the septum around said solid, means for partially removing fluid from solid through said septum, means for completing the removal of the fluid, means for subsequently washing the solid, means for removing the washing fluid from the solid, and means for unfolding the septum and removing the solid therefrom.

In testimony whereof, I have signed my name to this specification this 18th day of June, 1920.

SCOTT SYMINGTON. [L. s.]