Aug. 21, 1962 W. SIEPE 3,050,190

CENTRIFUGES

Filed Jan. 27, 1960

Fig. 1

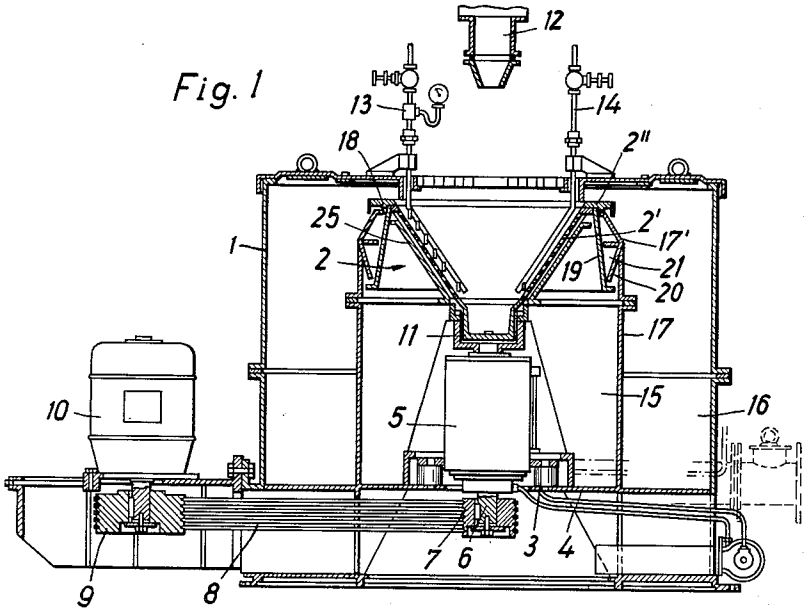
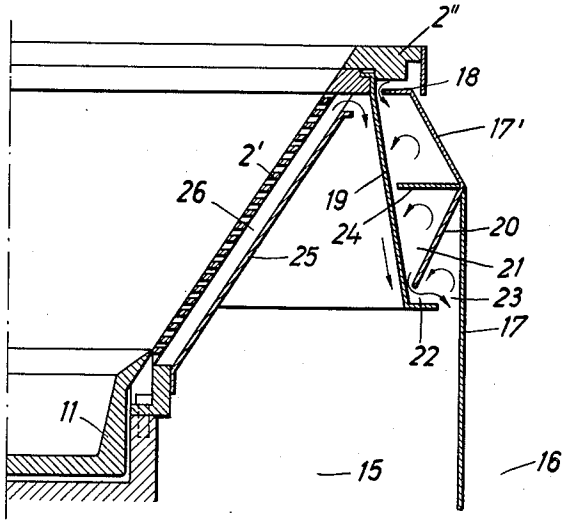


Fig. 2



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United States Patent Office 3,050,190
Patented Aug. 21, 1962

3,050,190

CENTRIFUGES

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Filed Jan. 27, 1960, Ser. No. 4,906
Claims priority, application Germany Feb. 25, 1959
4 Claims. (Cl. 210—380)

This invention relates to centrifuges for the continuous separation of mixtures of solids and liquids. The centrifuge in accordance with the invention is intended mainly for treating sugar masses and is of the type which comprises a perforated centrifuge drum which is rotated about a vertical axis and which widens from the bottom upwards, and two annular chambers arranged concentrically around the drum. The two annular chambers are separated from one another by a partition extending to the upper edge of the drum. The inner of the two chambers receives the liquid which passes through the openings in the drum and the outer chamber receives the solids leaving over the top edge of the drum.

In known centrifuges of the above type, it is difficult to obtain a perfect seal around the annular slot between the top edge of the drum and the partition separating the two annular chambers from one another, with the result that a portion of the liquid discharged through the perforations of the centrifuge drum may easily pass through the annular slot between the edge of the drum and the partition into the outer annular chamber which contains the solids which have been separated out, thereby making these solids wet again and making separation less complete. This may happen in two ways: Firstly, the liquid which has been separated out may creep up the partition and secondly the liquid may travel in the form of a fine mist or droplets, together with the air current produced by the rotation of the centrifuge drum, through the annular slot in the direction of the outer annular chamber which is intended to receive the solids. It has been found that it is the latter which is particularly important because the ventilation effect is particularly great in centrifuges which rotate at high speed. This effect is accentuated because the rotary parts of the centrifuge do not have a smooth outer surface, for reasons of strength, and the strengthening ribs or the like contribute quite considerably to the ventilation effect.

Previous proposals for solving this problem mainly consist in sealing off the annular gap between the upper edge of the drum and the partition by making the stationary machine parts and the rotating machine parts interengage in the form of a labyrinth. A baffle plate has been provided for this purpose at the top edge of the rotating centrifuge drum. This plate widens downwardly and projects a short distance into an intermediate chamber situated between the inner and the outer annular chamber. The liquid escaping from the annular slot which is to be trapped is separated in this intermediate chamber. Really satisfactory results have not been obtained by this means, however, because a relatively strong air current is produced which is directed from the inner to the outer annular chamber and allows the liquid to escape in the form of fine spray into the annular chamber for the solids.

The present invention is concerned with the problem of providing an effective seal in centrifuges of the above mentioned type in the annular gap between the upper edge of the drum and the partition, so that escape of liquid both as such and in the form of vapor or mist is safely avoided.

To this end, according to the present invention, in a centrifuge of the type described, an annular guide plate projects downwards and outwards from the top edge of

the drum into the inner annular chamber and a second guide plate projects downwards into the inner annular chamber from the partition, the guide plates forming between them a downwardly tapering flow chamber having an annular gap at its bottom, rotation of the drum causing an air current to pass downwards through this slot into the inner chamber.

The constant current of air produced in this way when the centrifuge is in operation prevents sprays or mists of liquid passing through the annular slot between the top edge of the drum and the partition. At the same time, the movement of liquid as such along the partition is prevented because the downwardly projecting, preferably cone-shaped, guide plate attached to the partition does not allow such a movement to take place.

The above described flow of air in the flow chamber and in the annular slot at the bottom of the flow chamber may be enhanced, according to a further feature of the invention, by surrounding the perforated centrifuge drum with a cone-shaped jacket with only a small distance between the drum and the jacket. This space becomes a suction space on rotation of the drum and has an open upper end which lies close to the top of the guide plate which is also preferably conical and which is fixed to the edge of the drum. The advantage of constructing the drum in this way with a cone-shaped jacket surrounding it is not only in that it increases the flow of air and liquid along the guide plate of the drum, which in turn strengthens the air current in the flow chamber, but also that the suction space between the perforated drum and the conical jacket exerts suction on the material to be centrifuged, which increases the separation of liquid along the perforated drum.

An embodiment of a centrifuge in accordance with the invention and its mode of operation will be described with reference to the accompanying drawing in which:

FIGURE 1 is a vertical section through the centrifuge; and,

FIGURE 2 is a similar section, but to a larger scale, of a part only of the centrifuge.

The sugar centrifuge shown in FIGURE 1 comprises a centrifuge drum 2 which is disposed in a housing 1 and is rotated about a vertical axis. The centrifuge drum 2 is conical with the base of the cone at the top and is mounted on a base 5 which is supported on the bottom 4 of the housing 1 by a rubber buffer 3. The drum 2 is driven by a shaft 6 which passes vertically through the base 5 and is rotated by an electric motor 10 through a pulley 7, a V-belt 8, and a pulley 9. To the bottom of the centrifuge drum 2 is fitted an accelerator cup 11 which widens upwardly and to which the mixture to be separated is supplied centrally through a pipe 12. The mixture passes from the cup 11 with increasing acceleration to a perforated separating wall 2' of the drum 2. Pipes 13 and 14 for the supply of solvents, detergents and bleaching agents are provided and end in suitable discharge openings at the inner surface of the wall 2'. Two annular chambers 15, 16 which are separated by a partition 17 are arranged concentrically inside the housing 1. The inner chamber 15 receives the molasses passing through the openings of the wall 2' while the solids, in the present case sugar crystals, which pass over the upper edge 2'' of the centrifuge drum 2 collect in the outer annular chamber 16. The partition 17 tapers conically in the upper portion 17' and extends to the upper edge 2'' of the drum 2 with which it encloses an annular slot 18.

To prevent the liquid molasses in the annular chamber 15 from passing through the annular gap 18 into the chamber 16 which is reserved for the sugar crystals, frustoconical guide plates 19 and 20 are fixed one to the

upper edge 2'' of the drum and the other to the partition 17. Both the plates 19 and 20 project downwards into the annular chamber 15. As shown most clearly in FIGURE 2, the two conical guide plates 19, 20 enclose an annular flow chamber 21, which has at its bottom an annular gap 22. As the guide plate 19 rotates at high speed with the drum 2 and widens towards the bottom in the shape of a cone, a flow of air which is constantly directed downwardly as indicated by the arrow 23 is established in the flow chamber 21 and particularly in the annular gap 22 while the centrifuge is in operation. This prevents liquid vapor or droplets from passing from the inner annular chamber 15 through the annular gap 18 into the outer collecting chamber 16. A baffle plate 24 which is fixed to the partition 17 above the flow chamber 21 also helps to produce this effect.

The above described aerodynamic sealing of the annular gap 18 can be improved by surrounding the wall 2' with a conical jacket 25 which is arranged at a slight distance from the wall 2' of the drum. This conical jacket is sealed at the bottom to the body of the drum 2. Together with the wall 2', it forms a suction chamber 26 the upper, open end 27 of which is situated near the top end of the frustoconical guide plate 19 which is connected to the drum. The conical jacket 25 which is fixed to the drum 2 and rotates with it produces a current of air and liquid which is deflected at the upper end of the guide plate 19, facing the wall 2', and thus reinforces the current already present on the inner side of the guide plate 19. The consequence of this is that the current of air in the annular gap 22, which effects the actual sealing, is reinforced by an injector action. The conical jacket 25 also has a very favorable effect on the separating process itself, since the suction effect from the suction space 26 causes intensive separation of liquid through the perforation in the wall 2'. The above described flow effects which form the centrifugal process as such and also separate from each other the two annular chambers which take up the liquid and the solids may, if desired, be further enhanced by providing more guide surfaces. It has been found, however, that the above described means, in particular the conical guide surfaces 19 and 20 and the conical jacket 25 are generally sufficient because they produce by themselves a sufficiently strong air current.

The invention thus produces flow conditions and ventilation effects, by suitable construction of the centrifuge drum and of the parts situated near the annular gap 18, to obtain satisfactory sealing of the annular gap and also assists the separation process itself, so that the overall effect of a considerably more satisfactory separation is obtained. If desired, the above mentioned flow conditions may be assisted or enhanced by blowing in air or similar gaseous media in the desired direction.

I claim:

1. A centrifuge for the continuous separation of a liquid from solids admixed therewith, comprising a housing, a drum in said housing with an open end and a perforated peripheral wall of generally conical configuration rotatable about an upright axis, said wall diverging toward said open end along said axis, a generally conical jacket rotatable with said drum about said axis and externally surrounding said wall with clearance, said wall and said jacket defining between them an annular suction space with an annular outlet at an upper end of said suction space, a stationary partition dividing the interior of said housing into an inner and an outer chamber concentrically surrounding said drum and said jacket, and guide means on said drum divergingly extending downwardly and outwardly from said outlet toward said partition and defining therewith an annular flow space terminating in an annular gap through which sealing air is drawn downwardly into said inner chamber from said outer chamber through said flow space by the rotation of said drum, said guide means including a downwardly and outwardly directed surface terminating at said gap and disposed adjacent said outlet for directing a fluid mass along the latter from said outlet past said annular gap, thereby promoting the flow of said sealing air.

2. A centrifuge for the continuous separation of a liquid from solids admixed therewith, comprising a housing, a drum in said housing with an open end and a perforated peripheral wall of generally conical configuration rotatable about a substantially vertical axis, said wall diverging upwardly toward said open end along said axis, a generally conical jacket rotatable with said drum about said axis and externally surrounding said wall with clearance, said wall and said jacket defining between them an annular suction space with an annular outlet at an upper end of said suction space, a stationary partition dividing the interior of said housing into an inner and an outer chamber concentrically surrounding said drum and said jacket, first frustoconical guide means on said drum divergingly extending downwardly and outwardly from said outlet and second frustoconical guide means convergingly extending downwardly and inwardly from said partition toward said first guide means and defining therewith an annular flow space terminating in an annular gap through which sealing air is drawn downwardly into said inner chamber from said outer chamber through said flow space by the rotation of said drum, said first guide means including a downwardly and outwardly directed surface terminating at said gap and disposed adjacent said outlet for directing a fluid mass along the said surface from said outlet past said annular gap, thereby promoting the flow of said sealing air.

3. A centrifuge for the continuous separation of a liquid from solids admixed therewith, comprising a drum with an open end and a perforated peripheral wall of generally conical configuration rotatable about a substantially vertical axis, said wall diverging upwardly toward said open end along said axis, a generally conical jacket rotatable with said drum about said axis and externally surrounding said wall with clearance, said wall and said jacket defining between them an annular suction space with an annular outlet at an upper end of said suction space, stationary wall means forming a chamber around said drum and said jacket, first frustoconical guide means on said drum divergingly extending downwardly and outwardly from said outlet, second frustoconical guide means convergingly extending downwardly and inwardly from said stationary wall means toward said first guide means and defining therewith an annular flow space terminating in an annular gap through which sealing air is drawn downwardly into said chamber from said flow space by the rotation of said drum, said first guide means including a downwardly and outwardly directed surface terminating at said gap and disposed adjacent said outlet for directing a fluid mass along said surface from said outlet past said annular gap, thereby promoting the flow of said sealing air, and baffle means extending inwardly from said second guide means toward said first guide means above said annular gap.

4. A centrifuge for the continuous separation of a liquid from solids admixed therewith, comprising a housing, a drum in said housing with an open end and a perforated peripheral wall of generally conical configuration rotatable about a substantially vertical axis, said wall diverging upwardly toward said open end along said axis, a generally conical jacket rotatable with said drum about said axis and externally surrounding said wall with clearance, said wall and said jacket defining between them an annular suction space with an annular outlet at an upper end of said suction space, a stationary partition dividing the interior of said housing into an inner and an outer chamber concentrically surrounding said drum and said jacket, a first frustoconical guide means on said drum divergingly extending downwardly

and outwardly from said outlet, second frustoconical guide means convergingly extending downwardly and inwardly from said partition toward said first guide means and defining therewith an annular flow space terminating in an annular gap through which sealing air is drawn downwardly into said inner chamber from said outer chamber through said flow space by the rotation of said drum, said first guide means including a downwardly and outwardly directed surface terminating at said gap and disposed adjacent said outlet for directing a fluid mass along said surface from said outlet past said annular gap, thereby promoting the flow of said sealing air,

and baffle means extending inwardly from said second guide means toward said first guide means above said annular gap.

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