July 13, 1943. F. K. KNUDSEN 2,323,920

METHOD OF AND APPARATUS FOR DEWATERING COMMINUTED MATERIALS

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FIG. 1.

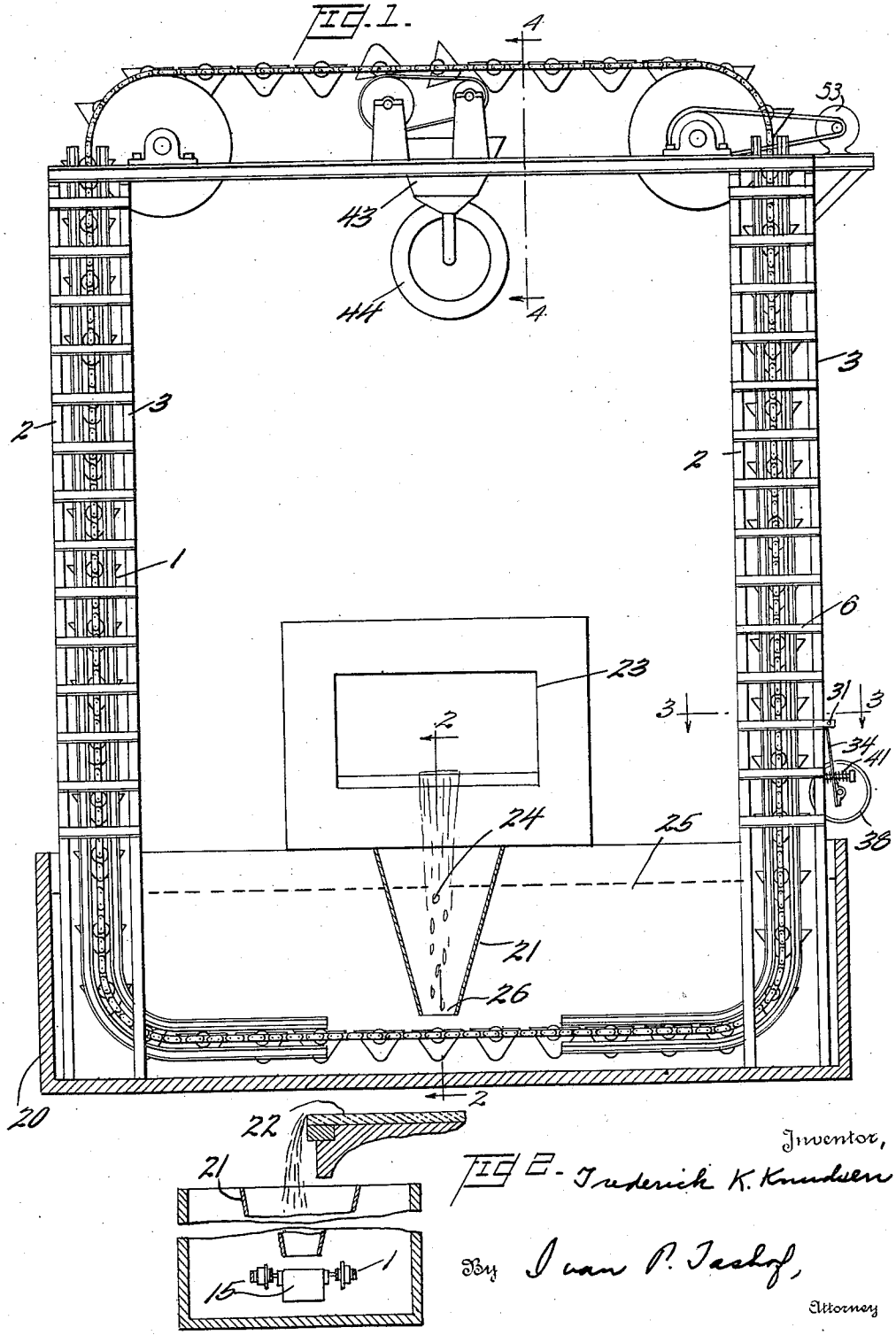

FIG 2.

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FIG. 3.

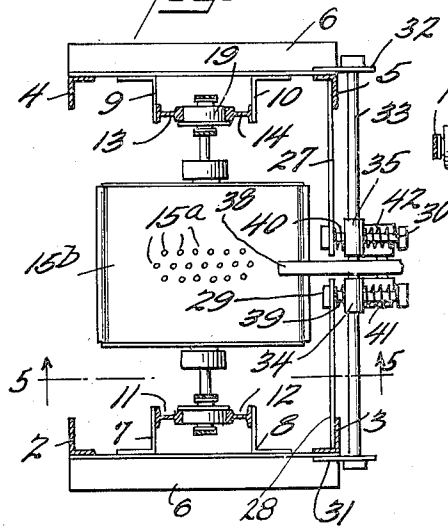


FIG. 4.

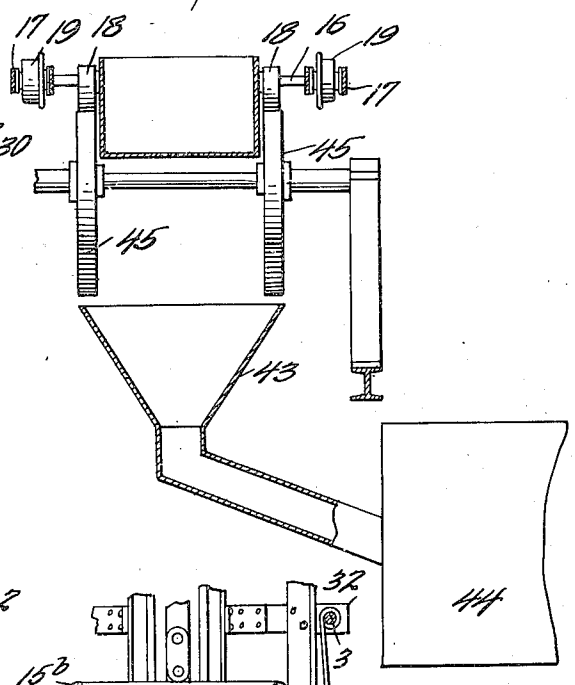


FIG. 5.

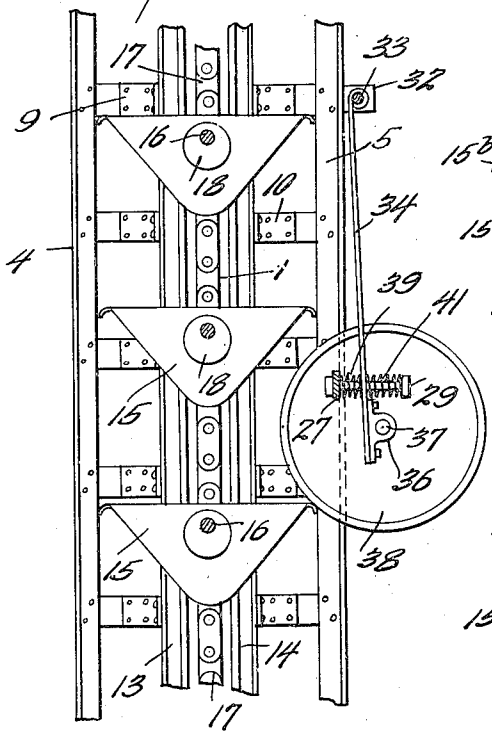
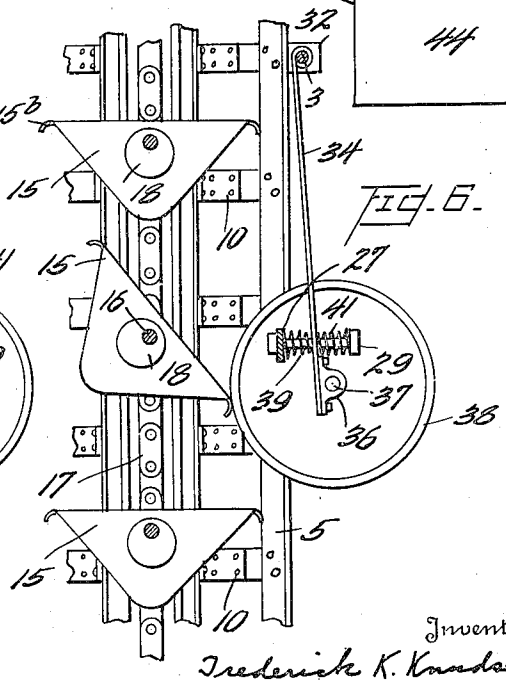


FIG. 6.



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METHOD OF AND APPARATUS FOR DEWATERING COMMINUTED MATERIALS

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FIG. 7.

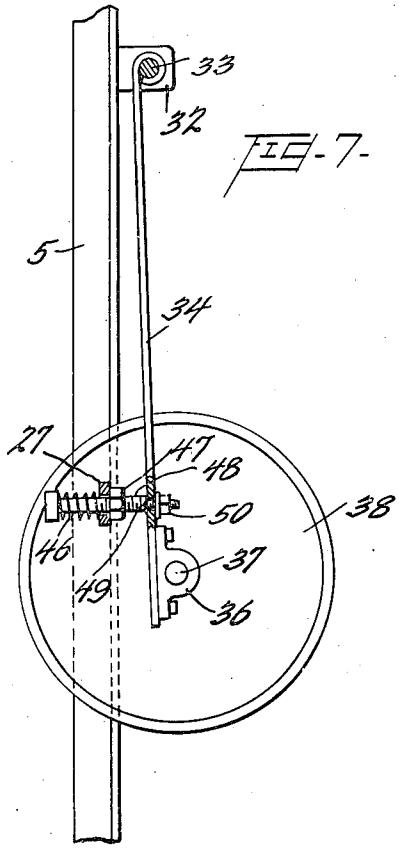


FIG. 8.

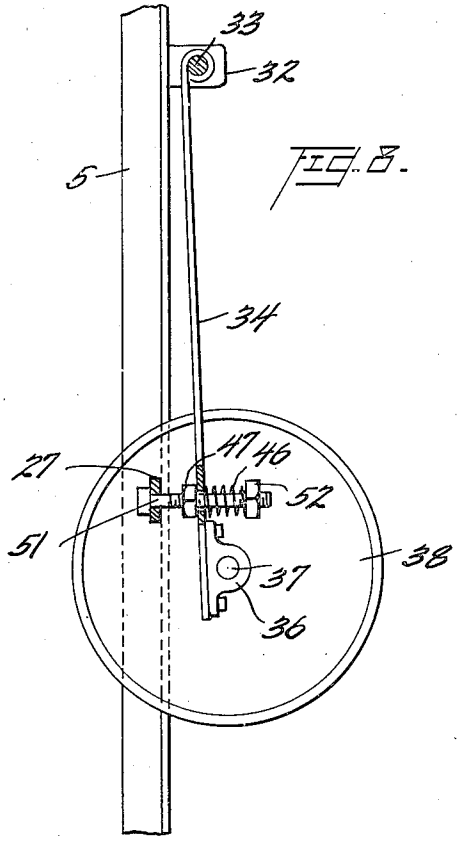
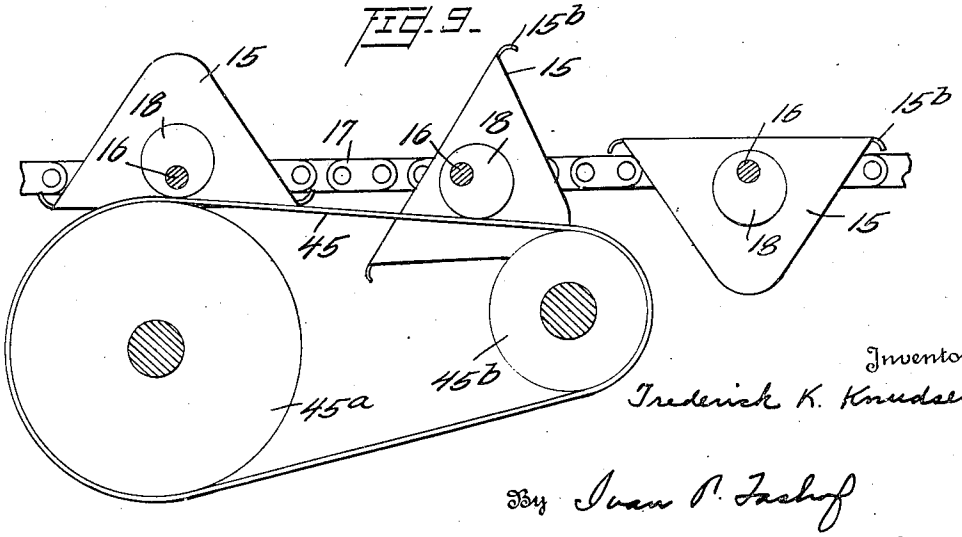


FIG. 9.



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METHOD OF AND APPARATUS FOR DEWATERING COMMINUTED MATERIALS

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Application September 30, 1939, Serial No. 297,378

13 Claims. (Cl. 210—55)

The present invention relates to the dewatering of shattered or comminuted material. While the invention will be disclosed in connection with the dewatering of porcelain enamel or vitreous enamel frit, it is to be understood that the invention is applicable to various solid materials, such as mineral flotation concentrates, coal concentrates, and lime, magnesium-containing and/or dolomitic materials adapted to be used for refractories.

It is quite customary to produce shattered, comminuted or granulated vitreous enamel or porcelain enamel frit by quenching the molten enamel in a water bath. The molten enamel or glass upon being brought into contact with the water is chilled thereby causing the solidified enamel, glass or frit to break into discrete particles, ranging in size from about one quarter of an inch to fine powders.

The shattered or comminuted frit is usually removed from the quenching pit by a continuous bucket conveyor, the buckets thereof being provided with perforated bottoms to allow for water drainage. The wet frit concentrates are usually delivered to a drainage bin and then to a drier.

Very frequently the water associated with the frit fails to completely drain from each bucket, due to the bucket perforations becoming clogged. As the buckets on the conveyor belt proceed upwardly on the conveyor tower to the drier the water dropping on successive batches of frit in successive buckets leaches from the frit soluble salts and the water with the soluble salts, together with the frit, is carried over into the drier, which is usually maintained at a temperature around 250° F. Upon evaporation of the water there is left in the drier a deposit of soluble salts consisting predominately of soluble sodium compounds, including sodium boro silicate and sodium silicate.

It is desired to point out that in a continuous conveyor that this deposit of soluble salts accumulates in the drier. Although the drying operation is a continuous one, very often these soluble salts are not continuously removed with the frit but build up in the drier and finally pass from the drier, together with some of the frit leaving the drier. In other words, in a continuous run a certain portion of the frit may have an unusual quantity of the soluble salts mixed therewith. These salts form an undesirable frit-ingredient and may affect the properties of the frit in various ways, as, for example, causing the frit, when smelted and applied to a base, to pit or cause specks in the final enamel, or so discolor the enamel produced from the frit as to make its utilization impossible.

From the above it is clear that it is highly desirable to substantially inhibit, or at least control, the carrying of water into the drier and the subsequent deposition from the water of salts or other compounds or ingredients. In accordance with the present invention this deposition is prevented by draining from each individual bucket, carrying, as, for example, two to three pounds of frit, substantially all of the free accompanying water, so that the frit introduced into the drier from successive buckets carries little free water. In other words, the only water that remains in the moist mass of frit is that which is adsorbed.

In accordance with the present invention the material undergoing treatment is dewatered and introduced directly into the drier without being carried to a drainage bin. Prior to the present invention, where the material in each bucket was dewatered, it was necessary to deliver the material raised by successive buckets to a drainage bin, so that the water mixed with the comminuted material could drain from the material to condition the latter for treatment in the drier. Proceeding in accordance with the present invention it is not necessary, to employ a drainage bin, since the material is at least superficially dewatered. On the contrary, the material is introduced directly into the drier. The elimination of the drainage bin saves the expense involved in the construction of the drainage bin, the feeder therefor, and the maintenance of these units. It may also be pointed out that the employment of the herein set forth dewatering arrangement greatly increases the efficiency of the drier, since the material entering the drier is associated with much less water and superficial moisture. As a result, the expense of the drying operation is materially decreased.

It is desired to point out that a further disadvantage of the use of a system in which no dewatering device is employed is that the drainage holes in the bottom of each bucket are not plugged uniformly, thereby resulting in unequal amounts of water being introduced into the drier at different times. As a result thereof, unless great care is used in operating the drier, the material coming therefrom is not properly dried.

In order that the present invention may be understood it will be described in connection with the accompanying drawings, in which:

Figure 1 is a side elevation, showing the conveyor tower and the dewatering device, the

quenching vessel and associated pit being shown in section.

Figure 2 is a vertical section taken on the line 2—2 of Figure 1.

Figure 3 is a horizontal section taken on the line 3—3 of Figure 1.

Figure 4 is a vertical section on the line 4—4 of Figure 1.

Figure 5 is a vertical section on the line 5—5 of Figure 3.

Figure 6 is a vertical section similar to Figure 5 showing one of the conveyor buckets in a dewatering position.

Figure 7 is a detail illustrating a modified spring suspension for the dewatering wheel.

Figure 8 is a detail illustrating a full modification of the spring suspension for the dewatering wheel.

Figure 9 is a vertical section illustrating the bucket rotating and dumping mechanism.

As shown in Figure 1, a conveying tower 1 is provided, the tower frame consisting of vertically extending angle irons 2, 3, 4, and 5. Extending transversely of the angle irons, at regular intervals, are the channel members 6. Mounted on each channel member and extending vertically of the tower frame are angle irons 7, 8, 9, and 10, which respectively carry the conveyor guide rails 11, 12, 13, and 14, upon which the bucket wheels 19 ride.

The buckets 15, which are perforated at 15a, are provided with rims 15b. Each bucket, which is carried by the chain 17, is swingably or rotatably mounted on the trunnion 16. Fixed on each bucket 15 is an eccentric 18, adapted to assist in the dumping of the bucket at an appropriate point in the bucket travel. It is to be noted that the guide rails extend inwardly at the bottom of the tower, so that the conveyor may change its direction of travel. This arrangement avoids the use of sprockets, which normally would be under water in the quenching pit 20.

The quenching vessel 21, which is suitably supported, in any desired manner, in the quenching pit 20, has falling therethrough a quenching medium which is usually water. The vessel 21 is positioned in the pit 20, below the discharge lip 22 of the smelter 23. The upper portion of the quenching vessel preferably extends slightly above the surface of the quenching water 25. The quenching vessel is of sufficient height to give a suitable quenching action to the falling frit particles 24.

The base portion 26 of the quenching vessel is sufficiently restricted to trap the enamel frit and guide it onto the conveyor buckets 15.

At an appropriate point in the bucket travel, means are provided to dewater the frit contents of each bucket. As specifically shown in Figures 3 and 5, fixed to the angle irons 3 and 5 are cross bars 27 and 28, in which are mounted bolts 29 and 30, adapted to carry spring members of the character hereinafter set forth. Fixed to the angle irons 3 and 5, at appropriate points, are bearing members 31 and 32, in which is journalled a rod 33, the latter having pivotally mounted thereon, for outward limited swinging motion, upright bars 34 and 35. The latter carry at their lower ends bearings 36, which support a shaft or axle member 37, on which the dewatering wheel 38 rotates. The bolts 29 pass through apertures in the transversely extending bar 28 and the longitudinally extending bar 34 and the bolt 30 passes through apertures in the transverse extending bar 27, and the longitudinally extending bar 35. The bolts 29 and 30 have nuts at both ends.

Spring members 39 and 40 are positioned around the bolts 29 and 30, the inner ends of the springs bearing against the cross bars 28 and 27, respectively, and at their other ends against the longitudinally extending swinging bars 34 and 35, respectively. Springs 41 and 42 are positioned between the longitudinal extending members 34 and 35 and the nuts on the outer ends of the bolts.

The operation of the device is as follows:

Assuming the conveyor is rotated by some suitable means, as, for example, the motor 53 and belt drive connected thereto, the buckets are moved in a circuitous path, as shown particularly in Fig. 1. At the lower central portion of the path the buckets are positioned under the quenching vessel 21, wherein comminuted material is produced. The comminuted material is deposited in the buckets and is carried in a counter-clockwise direction by the conveyor until the tilting device or dewatering wheel 38 is reached. The contact of the bucket rim 15b with the periphery of the dewatering wheel 38 causes a partial rotation of the bucket about its pivot, in the manner shown in Fig. 6. It is to be noted that the dewatering wheel is so positioned in relation to the path of the buckets that the maximum amount of rotation which takes place is only sufficient to dump the water from the bucket without dumping any of the frit or other shattered material. The dewatering wheel is normally kept in this desired position by the springs 41 and 42 which are sufficiently strong to prevent any outward movement of the dewatering wheel 38 when it contacts each bucket, except in those cases where an abnormal force is exerted. For example, if one of the buckets becomes stuck and fails to turn about its supporting axis, the outer springs 41 and 42 would become compressed under the abnormal force, thereby allowing the dewatering wheel 19 to move outwardly on a slight arc, which approaches a horizontal, thereby allowing the bucket to pass the dewatering wheel without causing any damage to the conveyor system or the dewatering wheel. If the dewatering wheel should fail to remove some small amount of water from the frit, the latter is drained from the frit through the perforations 15a, which are usually about one sixteenth of an inch in diameter. However, the size of the apertures will depend upon the size of the material being treated and other factors which may be worked out in practice.

Any suitable means may be provided for rotating the respective buckets to thereby allow the frit to pass from the buckets 15 to the take-off chute 43 and then to the rotary drier 44. This mechanism is illustrated in detail in Figure 9. As shown, the eccentrics 18 engage belts 45 carried by the wheels 45a and 45b. The wheel 45a is considerably larger than wheel 45b so that when the small portion of the eccentric 18 passes over the large wheel, the periphery thereof will remain in contact with the wheel and insure that the bucket is revolved through 180° so that the contents will be emptied therefrom. Just prior to completely passing over the wheel, the bucket is given an additional rotation which helps to right the bucket. It is to be noted that the bucket is ordinarily naturally weighted so that it tends to assume a position where the open end is uppermost.

In the modification of the device disclosed, and

shown particularly in Figures 1 to 6, four springs 39 to 42 inclusive, are provided, two of which, namely, springs 39 and 40 tend to force the pivot 37 away from the conveyor, whereas 41 and 42 tend to force the pivot 37 towoards the conveyor proper. This action of the springs tends to position the periphery of the dewatering wheel 38 in the proper position to contact the rims of the buckets 15 while at the same time permitting the dewatering wheel to move outwardly when the rotation of any one of the buckets is improperly prevented. In Figures 7 and 8, a modified suspension for the dewatering wheel is shown where only a single spring 46 is provided which permits the outward motion of the dewatering wheel 38 when the dewatering wheel 38 encounters an increased resistance during the rotation of the buckets. The movement of the dewatering wheel in an inward direction in these modifications is adjustably fixed by means of an adjusting nut which is indicated by the reference numeral 47. In the modification of Figure 7, the longitudinal member 34 which carries the pivot 37 is fixed on the bolt 48 as by a shoulder 49 on the bolt cooperating with a nut 50 and the spring 46 exerts a tension against the fixed horizontal support 27 and the left-hand end of the bolt 48 which tends to move the member 34 in a clockwise direction, i. e., towards the conveyor and buckets. In the modification shown in Figure 8, the member 34 is not fixed on the bolt 51 but is mounted loosely thereabout and the spring 46 bears against the member 34 at one end and the nut 52 on the bolt at the other, the head of the bolt 51 bearing against the horizontal crossbar 27.

It is desired to point out that the capacity of the carrying buckets is exceedingly high, but as a practical matter is limited by the amount of material that passes through the smelter in twenty-four hours. Exceedingly satisfactory results have been attained when twenty to thirty thousand pounds of smelted frit is carried by the buckets to and through the drier per twenty-four hours. This poundage, of course, may be greatly increased. If on a basis of thirty thousand pounds of fritted material passing through the system per twenty-four hours of operation, the amount of excess water eliminated per pound of frit be estimated at one ounce, which is actually considerable under the actual figure, it is evident that two thousand pounds of water will be saved from passing through the drying system per twenty-four hours of operation.

In view of the above it is clear that the present invention not only produces a frit which is uniform, as previously pointed out, by the drying of the frit is very economically affected.

In accordance with the present invention there is provided a method of continuously conveying wet vitreous enamel mixtures from a quenching pit to a moisture-removing conditioner for the frit. In this method the free aqueous component of the mixture is removed thereby inhibiting any leaching action of this component on the frit component of the mixture. This insures that successive batches of frit being introduced into the frit conditioner are free of leached salts. In other words, a method is provided for inhibiting the presence of leached compounds in frit mixtures introduced into the frit conditioner by removing the free aqueous component of the mixture shortly after the containers leave the quenching pit.

From an apparatus standpoint, the present invention resides in the provision of a conveyor carrying successive pivotally mounted buckets and means for partially rotating each bucket to remove the free liquid content thereof, without removing any of the comminuted material, which is normally carried along with the liquid. There is also provided, in accordance with the present invention, a resiliently mounted wheel or other suitable mechanism, which is adapted to cause a rotating or tipping action to dump any liquid in the buckets. The resilient mounting normally tends to maintain the tipping mechanism or wheel in the path of the buckets for tipping the same, but is capable of swinging the tipping mechanism out of the path of the buckets on abnormal operation, i. e. when the buckets will not properly rotate.

What is claimed is:

1. In combination, a conveyor, means to support said conveyor, means to move said conveyor, successive buckets pivotally mounted on the conveyor, means to feed comminuted material associated with a free liquid medium to said buckets, said comminuted material being subject to leaching effects on prolonged contact with said liquid, means positioned in the path of travel of said buckets and adjacent said feeding means for partially rotating each bucket to remove the free liquid contents thereof and prevent prolonged contact of said liquid and material to inhibit leaching of said material by said liquid, means remote from said feeding means to receive the comminuted material, and means independent of said means for partially rotating said buckets to completely rotate said buckets to discharge the comminuted material therefrom into said receiving means, said last mentioned means for completely rotating the buckets being positioned in the path of travel of said buckets adjacent said receiving means and remote from said means for partially rotating said buckets.

2. In combination, a movable conveyor carrying successive buckets pivotally mounted on the conveyor, said buckets containing comminuted material associated with a free liquid medium, means to support said conveyor, means to move said conveyor, means to supply said material and liquid medium to said conveyor, a resiliently mounted member normally positioned in the path of said buckets for partially rotating each bucket to remove the free liquid content thereof and means positioned in the path of travel of said buckets at a point remote from said resiliently mounted member for completely rotating said buckets to discharge the comminuted material therefrom.

3. In combination, a conveyor carrying successive buckets pivotally mounted on the conveyor, said buckets containing comminuted material associated with a free liquid medium, means to support said conveyor, means to move said conveyor, means to supply said material and liquid medium to said conveyor, means normally positioned in the path of the buckets for partially rotating each bucket to remove the free liquid content thereof, means to remove the means for partially rotating each bucket from the path of travel of a bucket on failure of said means for partially rotating each bucket to cause rotation of the bucket and means positioned in the path of travel of said buckets and remote from said first mentioned means for completely rotating said buckets to discharge the comminuted material therefrom.

4. In combination, a conveyor frame, a conveyor moving thereon, means to move said conveyor, said conveyor carrying pivotally mounted successive containers of comminuted material associated with free liquid, means to feed the comminuted material and liquid to said containers, a member extending transversely of said frame, a longitudinally extending member pivotally mounted on said transverse member for a limited swinging outward movement a deliquefying wheel rotatably mounted on said longitudinally extending member, said wheel being positioned to contact each container and partially rotate the same to deliquefy the contents thereof and means to discharge the comminuted material separated from the liquid from said container.

5. In combination, a conveyor frame, a conveyor moving thereon, means to move said conveyor, said conveyor carrying pivotally mounted successive containers of comminuted material associated with free liquid, means to feed the comminuted material and liquid to said containers, a member extending transversely of said frame, a longitudinally extending member pivotally mounted on said transverse member for a limited swinging outward movement, a deliquefying wheel rotatably mounted on said longitudinally extending member, said wheel being positioned to contact each container and partially rotate the same to deliquefy the contents thereof, means urging said deliquefying wheel into the path of travel of said containers, said means being yieldable so that said wheel will be moved from the path of travel of the container upon failure of the deliquefying wheel to cause rotation of a container and means to discharge the comminuted material separated from the liquid from said containers.

6. In combination, a conveyor frame, guide rails on said frame, a moving conveyor member carrying pivotally mounted successive buckets of comminuted material associated with free liquid, means to move said conveyor member, means to feed comminuted material and liquid to said buckets, means on said buckets for cooperating with the guide rails to maintain the movement of the buckets within a fixed path, a member extending transversely of said frame, a longitudinally extending member pivotally mounted on said transverse member for a limited swinging outward movement a deliquefying wheel rotatably mounted on said longitudinally extending member, said wheel being positioned to contact each container and partially rotate the same to deliquefy the contents thereof and means to discharge said material separated from the liquid from said containers.

7. In combination, a conveyor frame, a conveyor moving thereon, means to move said conveyor, said conveyor carrying pivotally mounted successive containers of comminuted material associated with free liquid, means to feed the comminuted material and liquid to said containers, a member extending transversely of said frame, a longitudinally extending member pivotally mounted on said transverse member for a limited swinging outward movement, a deliquefying wheel rotatably mounted on said longitudinally extending member, said wheel being positioned to contact each container and partially rotate the same to deliquefy the contents thereof, means urging said deliquefying wheel into the path of travel of said containers, said means being yieldable so that said wheel will be moved from the path of travel of the container upon failure of the deliquefying wheel to cause rotation of a container, said last-mentioned means including a spring for normally maintaining said wheel in the path of travel of said containers and means to discharge the comminuted material separated from the liquid from said containers.

8. In combination, a conveyor frame, guide rails on said frame, a moving conveyor member carrying pivotally mounted successive buckets of comminuted material associated with free liquid, means to move said conveyor member, means to feed comminuted material and liquid to said buckets, means on said buckets for cooperating with the guide rails to maintain the movement of the buckets within a fixed path, a member extending transversely of said frame, a longitudinally extending member pivotally mounted on said transverse member for a limited swinging outward movement, a deliquefying wheel rotatably mounted on said longitudinally extending member, said wheel being positioned to contact each bucket and partially rotate the same to deliquefy the contents thereof, means urging said deliquefying wheel into the path of travel of said buckets, said means being yieldable so that said wheel will be moved from the path of travel of the buckets upon failure of the deliquefying wheel to cause rotation of a bucket and means to discharge said material separated from the liquid from said buckets.

9. In combination, a conveyor frame, a conveyor moving thereon, means to move said conveyor, said conveyor carrying successive buckets pivotally mounted on the conveyor, said buckets containing comminuted material associated with a free liquid medium, means to feed the material and liquid medium to said buckets, a member extending transversely of said frame, a longitudinally extending member pivotally mounted on said transverse member, means passing through said longitudinally extending member and through a fixed portion of the frame for limiting the outward swinging movement of said longitudinally extending member, a spring carried by said last-mentioned means urging said longitudinally extending member inwardly, a deliquefying wheel rotatably mounted on said longitudinally extending member, said wheel being positioned in the path of said buckets and adapted to partially rotate each bucket to deliquefy the contents thereof and means to discharge the material separated from the liquid.

10. In combination, a conveyor frame, a conveyor moving thereon, means to move said conveyor, said conveyor carrying successive buckets pivotally mounted on the conveyor, said buckets containing comminuted material associated with a free liquid medium, means to feed the comminuted material and liquid medium to said buckets, a member extending transversely of said frame, a longitudinally extending member pivotally mounted on said transverse member, means passing through said longitudinally extending member and through a fixed portion of the frame for limiting the outward swinging movement of said longitudinally extending member, a spring carried by said last-mentioned means urging said longitudinally extending member inwardly, means to adjustably vary the outward position of said member, a deliquefying wheel rotatably mounted on said longitudinally extending member, said wheel being positioned in the path of said buckets and adapted to partially rotate each bucket to deliquefy the con-

tents thereof and means to discharge the deliquefied comminuted material from said buckets.

11. In the substantially continuous conveying in containers of a wet vitreous enamel mixture from a quenching pit to a moisture-removing conditioner for the frit, the step of removing the free aqueous component of the mixture and inhibiting the leaching action of the aqueous component on the frit component, whereby successive batches of the frit introduced into the frit conditioner are substantially free of leach salts.

12. In the substantially continuous conveying in containers of a wet vitreous enamel mixture from a quenching pit to a moisture-removing conditioner for the frit, the step of substantially inhibiting the presence of leached compounds in a frit mixture introduced into the frit conditioner by removing the free aqueous component of the mixture shortly after the containers leave the quenching pit.

13. In the substantially continuous conveying of wet vitreous enamel mixtures from a quenching bath to a moisture removing conditioner the steps which comprise, removing the greater part of the free aqueous component of said mixture shortly after the mixture leaves the quenching bath to inhibit the leaching action of the water on the enamel, slowly draining substantially the remainder of the water from the enamel while conveying the same from the quenching bath to the conditioner, and feeding the resultant water-free enamel to the conditioner.

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