Nov. 26, 1940. G. LINKE 2,222,777

GYRATORY WASHER

Filed Feb. 20, 1939

Fig. 1

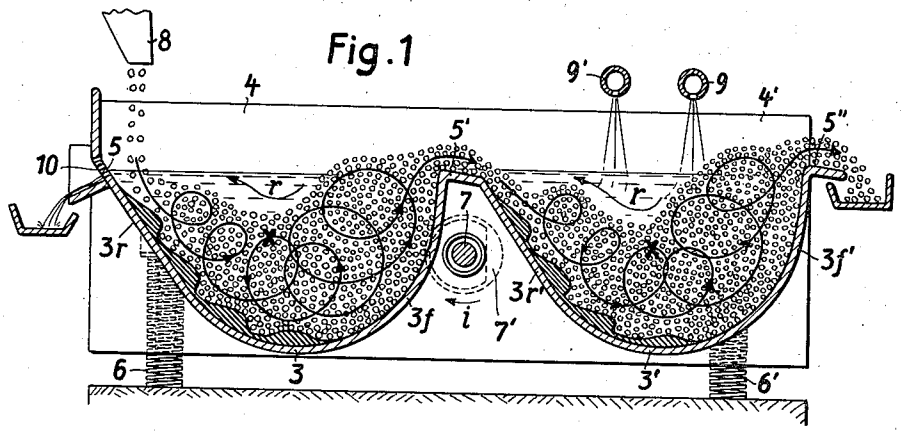


Fig. 3

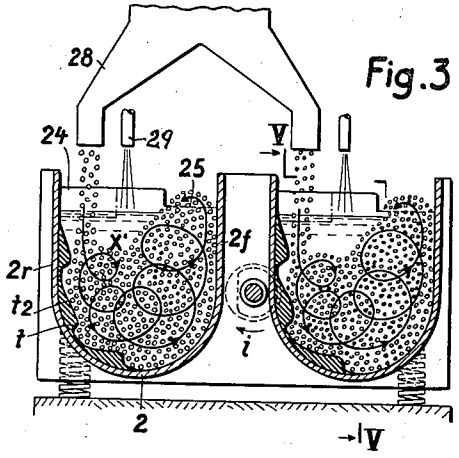


Fig. 4

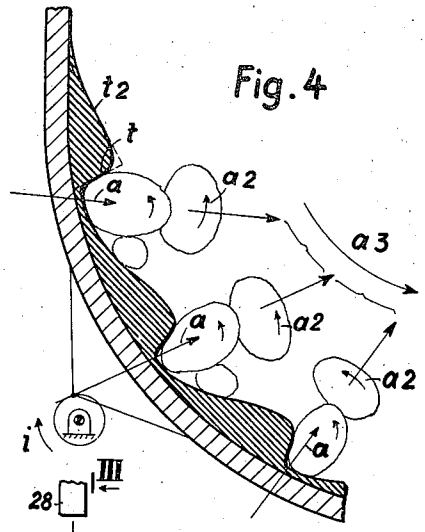
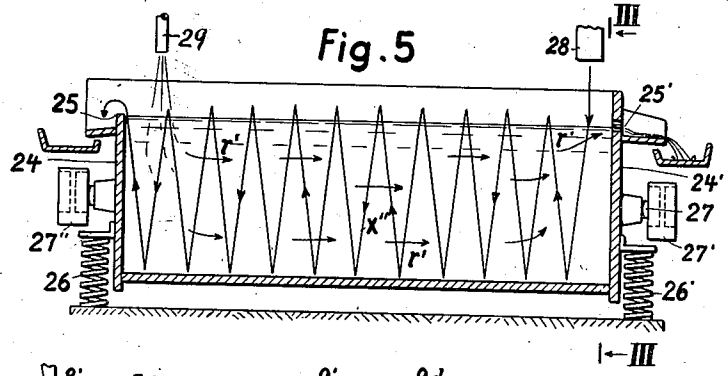


Fig. 5



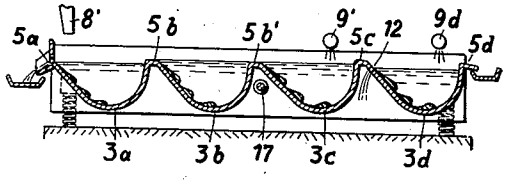


Fig. 2

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UNITED STATES PATENT OFFICE

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GYRATORY WASHER

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Application February 20, 1939, Serial No. 257,352
In Germany February 26, 1938

4 Claims. (Cl. 209—446)

This invention deals with the problem of washing and scrubbing in a continuous, speedy and highly economical manner coarse and fine aggregates in bulk, such as crushed ore, chips of stone, gravel, sands and like minerals with the object of loosening and separating gravel and sands lumped together and coated with hard crusts of clay, lime, saline or organic matters from the adhering foreign substances, thereby preparing the material for grading and other operations, for instance mixing of mortars and concrete, or preparing crushed ore mixed with gangues for a subsequent chemical or thermic treatment such as roasting, sintering, smelting etc.

The invention relates more particularly to improvements in gyrating washing and scrubbing machines of the type shown and described in a co-pending United States patent application jointly filed by Gerhard Linke and August Voegel on September 27, 1937, Ser. No. 165,859.

A preferred form of the gyrating washing and scrubbing machine disclosed in said earlier patent application comprises a plurality of perforated scrubbing troughs having one-dimensionally curved inner working or impeller faces and being adjacently to each other arranged side by side for communication at their crests, the latter being substantially in a level straight line, of side walls closing the ends of said troughs and extending above their crests, means for gyrating said troughs in clockwise direction, namely in closed cycles of movement perpendicular to their crests, and means for sprinkling water over the material under treatment in the troughs.

An outstanding feature of said washing and scrubbing machine, which is a predecessor of this invention, consists in that the material fed into the machine by virtue of its intimate contact and frictional engagement with the inner working faces of the gyrating troughs is dynamically—as against statically or gravitationally—advanced, namely spontaneously migrates transversely through the troughs by incidentally climbing over their crests, while the sprinkling water distributed over the material is discharged through the perforated bottom of the troughs.

The principal object of this invention is to so re-design gyrating washing and scrubbing machines of the type disclosed in said earlier United States patent application, that the material under treatment is still more thoroughly washed and cleaned, namely that the hard and dry foreign substances referred to above which often tenaciously stick to the lumps and granules of the material are to a higher degree soaked in water and more completely mollified, loosened, dissolved and separated, while on the other hand the net quantity of water required therefor is substantially reduced.

In connection therewith the invention aims at providing the gyrating washing and scrubbing machine concerned with improved means for promoting the migration of the material through the troughs and intensifying its climbing tendency.

Other advantages obtained by this invention will become incidentally apparent to practitioners in this field as the description proceeds.

The nature and scope of this invention are briefly outlined in the appended claims and will be more fully understood from the following specification taken together with the accompanying drawing, in which

Fig. 1 is a cross section vertically taken at the median plane of symmetry through a washing and scrubbing machine re-designed according to this invention and diagrammatically shown by way of an example;

Fig. 2 is a cross section vertically taken through a structurally modified washing and scrubbing machine designed according to this invention and shown in a smaller scale;

Fig. 3 is a cross section vertically taken on line III—III in Fig. 5 through another structurally modified washing and scrubbing machine;

Fig. 4 is a fragmentary cross section showing in a larger scale one of the scrubbing troughs shown in Fig. 3;

Fig. 5 is a longitudinal section vertically taken on line V—V in Fig. 3 through one of the scrubbing troughs.

One of the most important features of the washing and scrubbing machine re-designed with the objects in view outlined above consists in that the scrubbing troughs are made in the form of bath tubs, namely being closed all around at their four sides and having no perforations in the bottom; namely in contradistinction to the prior art scrubbing machines referred to above, the troughs of which were perforated allowing the washing liquid sprinkled over the material to flow off soon and to take with it an ample proportion of fines which are liable to be lost and to clog the perforations.

Another salient feature of the invention consists in that in accordance with the so-called counter-current principle the material and the water are fed into the machine at opposite points thereof, so that they must pass through the individual scrubbing troughs in opposite directions to each other.

As the result of the adoption of the counter-current principle and the prolonged immersion of the material in the cleansing liquid the foreign substances adhering to the material are thoroughly soaked, completely mollified or dissolved and incidentally separated; the material coming into contact—just before being discharged—with the fresh inflowing water will leave the machine in a highly cleaned condition.

In their re-designed constructional form the scrubbing troughs of the machine may have thick walls and a thick bottom adapted to resist hard and long wear, while the perforated scrubbing troughs of the prior art machines referred to above had to be provided with walls as thin as possible, or else the discharge apertures will be easily clogged.

It is true that the apertures in the prior art troughs could have been made large enough to prevent clogging; but in that case an excessive proportion of the material, namely including fine and coarser particles, would be carried off with the water.

According to this invention the overflowing water passes through a strainer, by which fines suspended in the water are retained.

Still another noteworthy feature of the invention consists in the provision of propelling members in the scrubbing troughs so designed and arranged, that the lumps and granules of the material in direct contact with said propelling members by virtue of their quick gyrating motion are violently knocked off and incidentally rolled around in a direction opposed to that in which the trough is gyrated, as shown in a somewhat exaggerated manner and indicated by arrows *a*, *a*2 in Fig. 4, namely with the result that the whole mass of material in the troughs is dynamically propelled in the resultant direction indicated by arrow *a*3, so as to ascend on the front walls of the troughs and eventually climb over their overflow edges as described in detail hereinafter.

The said material propelling members are particularly useful when dealing with materials the specific gravity of which is only slightly higher than that of water, such as pumice-stone, rhyolites, asbestos, tremolite, etc., in as much as by their immersion in water their active weight and consequently their impulse transmitting frictional contact with the impeller, inner working faces of the scrubbing troughs are considerably reduced.

Referring now to the structural details of the washing and scrubbing machines shown by way of examples in the drawing, the machine diagrammatically shown in cross section in Fig. 1 comprises:

(1) Two substantially horizontally disposed material receiving troughs arranged side by side so as to form a structural unit and having a one-dimensionally curved bottom **3**,**3**', ascending front and rear walls **3***f*, **3***f*', **3***r*, **3***r*' and upright side walls **4**, **4**', extending above said front and rear walls; the latter are formed at their upper ends with overflow edges **5**, **5**', **5**'' arranged at different levels, the edge **5** at the feed end of the machine being at the lowest level, while the edges **5**', **5**'' are on progressively higher levels; the said troughs are yieldingly supported by springs **6**, **6**';

(2) Means for gyrating said troughs comprising a rotary shaft **7** carrying an excentric **7**' and means (not shown) for rotating said shaft and excentric in clockwise direction indicated by arrow *i*;

(3) A chute **8** arranged above the rear wall **3***r* of the first trough for feeding the material thereinto and

(4) A sprinkler pipe **9** arranged above the second trough at a distance from the highest overflow edge **5**'' so chosen that the fresh water although still acting upon the outgoing material and cleansing it will not be substantially carried away with the material, but will flow through both troughs in the direction of the arrows *r* and pass eventually out over the lowest overflow edge **5**,—while the material agitated and rolled around in the troughs spontaneously migrates therethrough and over the overflow edges **5**', **5**'' in interlooping paths of movement indicated by arrows *x*.

The inventor's experiments have shown, that the spontaneous migration of the material through the troughs and its climbing tendency are promoted and intensified by providing the rear walls **3***r*, **3***r*' with corrugated inner working faces; the corrugations present in their preferred form as to their cross sectional shape right angled triangles having rounded off corners, the sides *t*, *t*2 of said triangles being proportioned relatively to each other at the ratio of *t*:*t*2=1:2.

In addition to the sprinkler pipe **9** one or more other such pipes, designated **9**' in Fig. 1, may be conveniently provided; a strainer **10** may be fixed to advantage at the lower overflow edge **5** of the first trough for retaining fines of the material liable to be carried away with the overflowing bathing water.

In the structurally modified washing and scrubbing machine, shown in a smaller scale and by way of another example in Fig. 2, there are troughs **3***a*, **3***b*, **3***c*, **3***d* of substantially the same design as described with reference to Fig. 1 co-operatively associated side by side forming a series of four troughs and a structural unit; there are five overflow edges **5***a*, **5***b*, **5***b*', **5***c*, **5***d* provided on said troughs at progressively higher levels, a chute **8**' for feeding the material into the first trough **3***a* and sprinkler pipes **9***c*, **9***d* for supplying bathing water into the last trough **3***d* and into the last but one trough **3***c*; the last trough **3***d* is formed at its feed end with drainage holes **12** just below the overflow edge **5***c*; means diagrammatically indicated at **17** are provided for bodily gyrating the troughs in clockwise direction.

Various other modifications and changes may be conveniently made in the structural details of washing and scrubbing machines of the improved design described, without substantially departing from the spirit and the salient ideas of this invention, namely carrying out the "counter-current" working principle:

In the washing and scrubbing machine shown in Figs. 3, 4, 5 by way of still another example there are two substantially horizontally disposed troughs of modified design structurally associated so as to form a twin machine; each trough has a one-dimensionally curved bottom **2**, ascending rear and front walls **2***r*, **2***f* and upright side walls **24**, **24**'; the latter are formed with overflow edges **25**, **25**' arranged at different levels, namely edge **25** of the left side wall **24** being at a higher level than edge **25**' of the upright side wall **24**'; the rear walls **2***r* of the troughs have corrugated working faces *t*, *t*2 preferably of the design shown in a larger scale in Fig. 4 for promoting the agitation

and migration of the material through the troughs;

The machine is yieldingly supported by springs **26**, **26'** and is gyrated in clockwise direction by a rotary shaft **27** and excentrics **27'**, **27''**.

The material under treatment dropping from the chute **28** into the corner between the rear wall **2r** and the right side wall **24'** and will be dynamically advanced and gravitationally proceed through the trough in a helical path of interlooping movements indicated by the arrows *x'*, *x''* in Figs. 3 and 5 and will finally pass out of the trough by climbing over the higher overflow edge **25**; while the water supplied by the sprinkler pipe **29** into the trough near its left side wall **24** will flow in opposite direction, indicated by the arrows *r'*, through the trough and will be discharged at the lower overflow edge **25'** of the right side wall **24'**.

1. A machine for continuously scrubbing bulk material comprising a trough-shaped container having a bottom portion curved about an axis extending longitudinally of said trough, overflow edges, arranged at different heights and at opposite sides of said trough, means for feeding granular material into said trough adjacent the lower of said overflow edges, means for introducing a washing liquid adjacent the higher of said overflow edges, and means for gyrating said trough in a path lying in a plane perpendicular to said axis and in such a direction as to be clockwise when the trough is viewed from one end with the lower overflow edge on the left and the upper overflow edge on the right.

2. A machine for continuously scrubbing bulk material comprising a trough-shaped container having a bottom portion curved about an axis extending longitudinally of said trough and being formed with corrugations, overflow edges, arranged at different heights and at opposite sides of said trough, means for feeding granular material into said trough adjacent the lower of said overflow edges, means for introducing a washing liquid adjacent the higher of said overflow edges, and means for gyrating said trough in a path lying in a plane perpendicular to said axis and in such a direction as to be clockwise when the trough is viewed from one end with the lower overflow edge on the left and the upper overflow edge on the right.

3. A machine for continuously scrubbing bulk material comprising a trough-shaped container having a bottom portion curved about an axis extending longitudinally of said trough and being formed with corrugations, overflow edges, arranged at different heights and at opposite sides of said trough, means for feeding granular material into said trough adjacent the lower of said overflow edges, means for introducing a washing liquid adjacent the higher of said overflow edges, and means for gyrating said trough in a path lying in a plane perpendicular to said axis and in such a direction as to be clockwise when the trough is viewed from one end with the lower overflow edge on the left and the upper overflow edge on the right, said corrugations presenting as to their cross sectional shape right angled triangles having rounded off corners.

4. A machine for continuously scrubbing bulk material comprising a trough-shaped container having a bottom portion curved about an axis extending longitudinally of said trough and being formed with corrugations, overflow edges, arranged at different heights and at opposite sides of said trough, means for feeding granular material into said trough adjacent the lower of said overflow edges, means for introducing a washing liquid adjacent the higher of said overflow edges, and means for gyrating said trough in a path lying in a plane perpendicular to said axis and in such a direction as to be clockwise when the trough is viewed from one end with the lower overflow edge on the left and the upper overflow edge on the right, said corrugations presenting as to their cross sectional shape right angled triangles having rounded off corners, the sides of said triangles projecting into the trough transversely to its axis and being proportioned at the ratio of about one to two, the shorter side facing the bottom of the trough.

GERHARD LINKE.