

July 20, 1943.

W. C. MOOR

2,324,637

LIQUID SCREENING APPARATUS

Filed Oct. 4, 1939

3 Sheets-Sheet 1

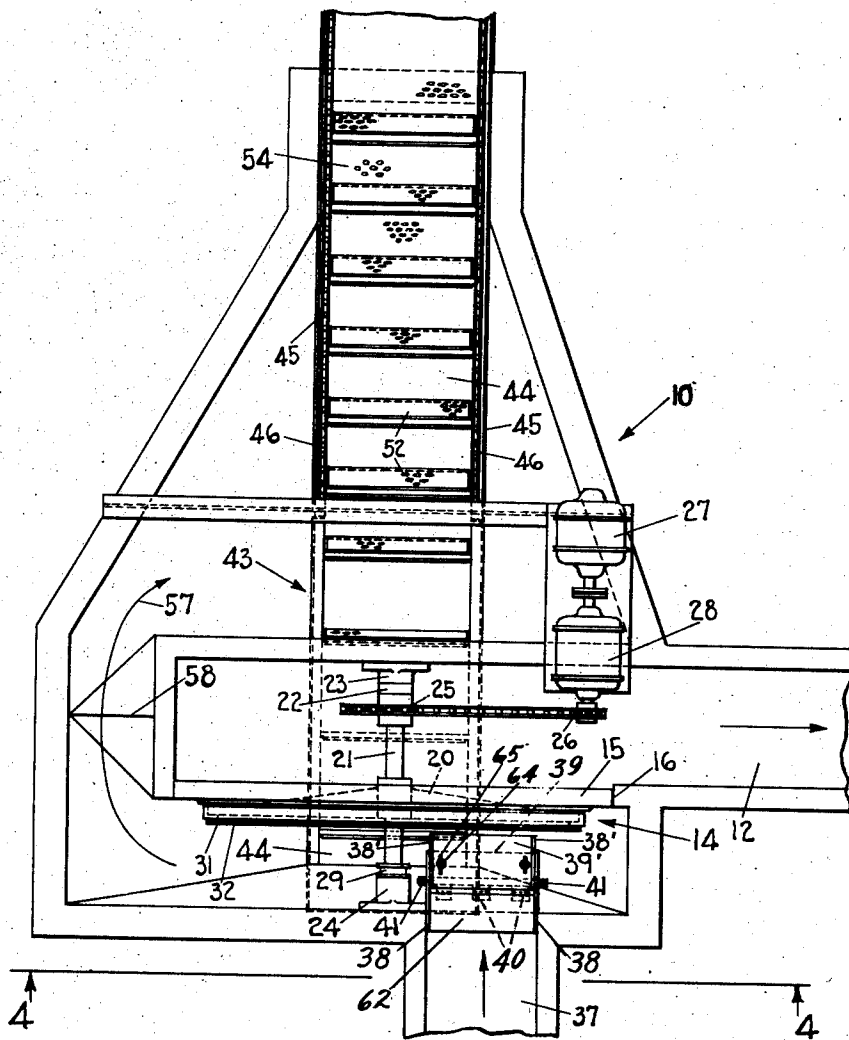


Fig. 1

INVENTOR:

WILLIAM C. MOOR,

By *Chas. M. Thiesen*,

ATTY.

July 20, 1943.

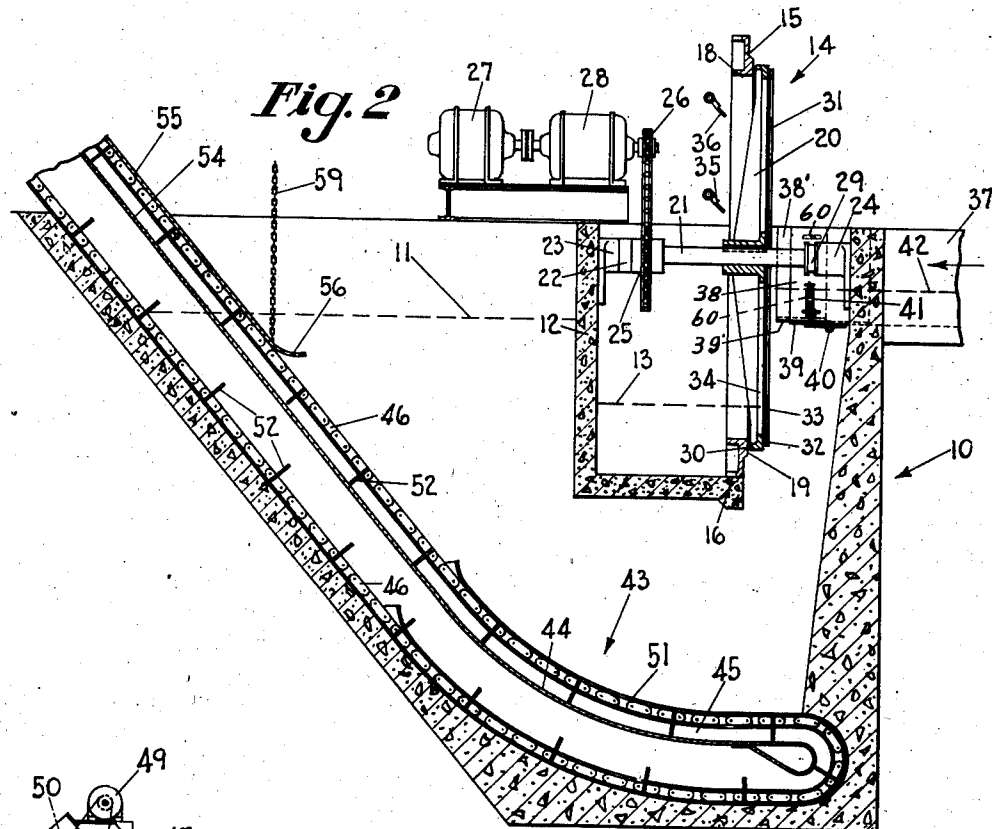
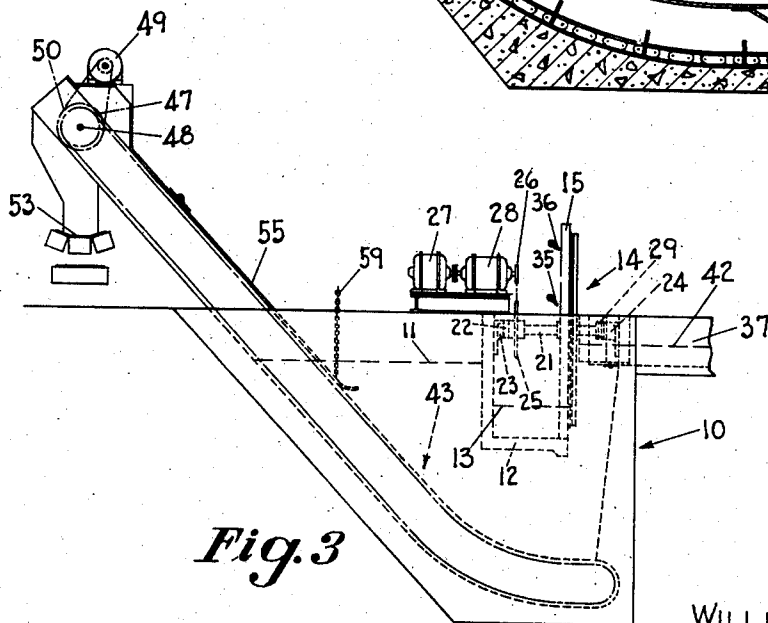
W. C. MOOR

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3 Sheets-Sheet 2



INVENTOR:
WILLIAM C. MOOR,
By *Chas. M. Nissen*,
ATTY.

July 20, 1943.

W. C. MOOR

2,324,637

LIQUID SCREENING APPARATUS

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3 Sheets-Sheet 3

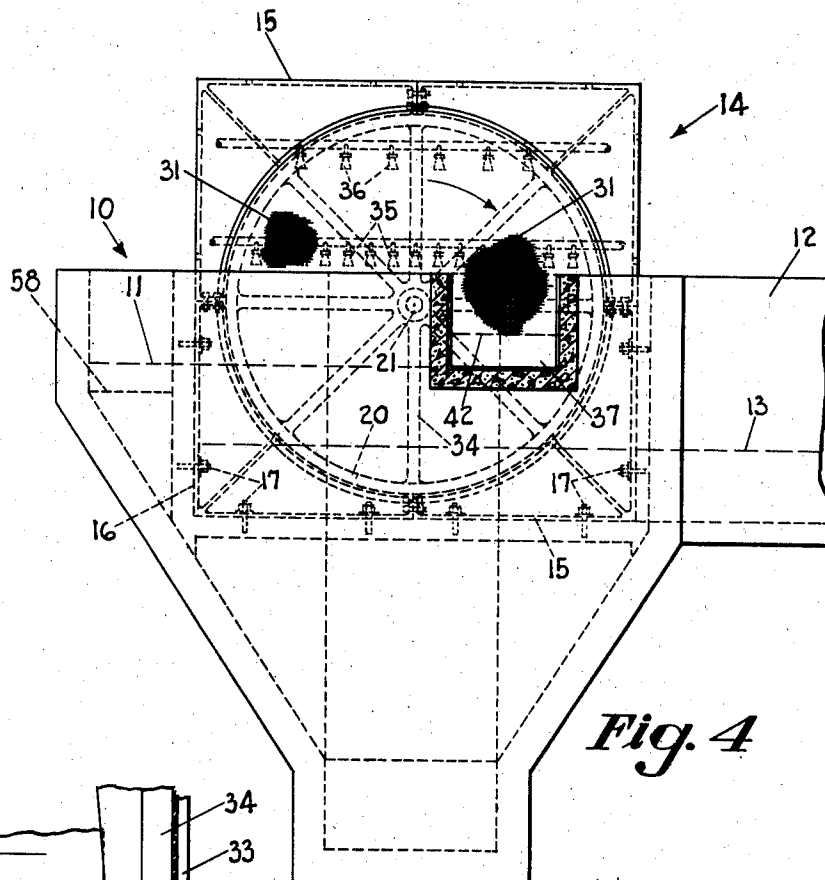


Fig. 4

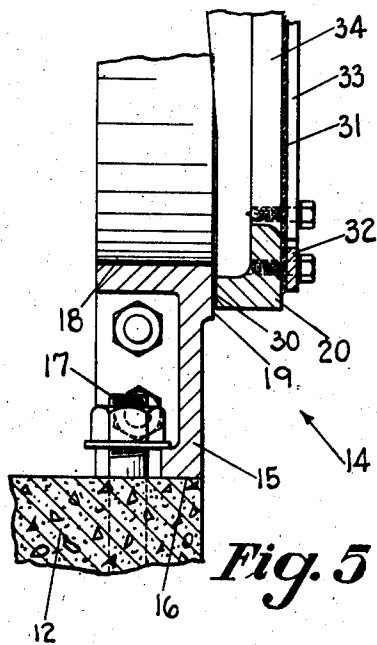


Fig. 5

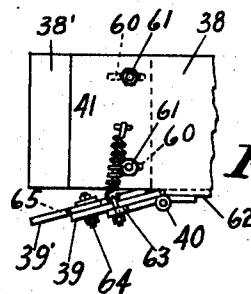


Fig. 6

INVENTOR;
WILLIAM C. MOOR,
By *Char. M. Nissen*,
ATTY.

UNITED STATES PATENT OFFICE

2,324,637

LIQUID SCREENING APPARATUS

William C. Moor, Fort Worth, Tex., assignor to
The Jeffrey Manufacturing Company, a corporation of Ohio

Application October 4, 1939, Serial No. 297,905

13 Claims. (Cl. 210—196)

This invention relates to liquid screening apparatus and particularly to apparatus for removing solids from liquids, illustrations of which are the separation of sewage solids from the liquid as well as the separation of solids found in liquids from slaughter-house and industrial wastes.

An object of the invention, therefore, is to produce screening apparatus of the above mentioned type which is very efficient in operation, yet simple of construction.

Another object of the invention is to provide an improved rotary disk screen structure.

Still another object of the invention is to provide liquid treating apparatus including a special conveyor for removing solids from liquids with a minimum of liquid carry-over.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings,

Fig. 1 is a plan view of the apparatus comprising my invention;

Fig. 2 is a sectional elevational view substantially along the center line thereof;

Fig. 3 is a diagrammatic side elevational view of the apparatus;

Fig. 4 is a sectional elevational and end view taken on the line 4—4 of Fig. 1 looking in the direction of the arrows;

Fig. 5 is an enlarged sectional view showing a detail of the disk screen; and

Fig. 6 is an enlarged side elevation of the discharge end of the influent sluice.

Referring to the accompanying drawings, it will be seen that I have provided a receptacle or tank 10 which is in the form of a concrete pit, though it may be made of other material, such as cast iron or steel, which pit is adapted to receive the liquid from which the solids are to be removed, such as sewage, slaughter-house waste or industrial waste, the normal liquid level in said tank 10 being indicated by the line 11 in Fig. 2.

Forming a part of said tank 10 is an effluent sluice 12 by which the cleaned water flows from said tank 10 in the direction of the arrow indicated in Fig. 1 of the drawings.

The normal water level of the liquid in the sluice 12 is indicated by the line 13 in Fig. 2 of the drawings which is of course below the water level 11 due to a loss of head as hereinafter described. The water permitted to flow into the effluent sluice 12 is screened by a substantially vertical rotary disk screen 14 which is effective to remove the solids which are delivered to the tank 10 as hereinafter described.

The screen 14 comprises a frame 15 which may, for example, be made in the form of four similar castings which are bolted together. Said frame 15 is bolted to walls of the sluice 12 adjacent an opening 16 provided in one face thereof by means of anchor bolts 17.

The frame 15 provides a cylindrical opening 18 and at its outer edge has a finished or machined face 19 for a purpose hereinafter described. Said screen 14 also includes a rotor comprising a frame 20 having a hub keyed to a shaft 21 and having a press fit therewith.

Shaft 21 is journaled in journal bearings 23 and 24 mounted on the walls of the sluice 12 and the tank 10, respectively, the former of which co-operates with adjustable collar 22 to provide a thrust bearing providing for adjustment of the position of frame 20 relative to frame 15. Adjacent one end shaft 21 carries a drive sprocket 25 driven through chain and sprocket drive mechanism 26 from a variable speed electric motor 27 and a speed reducer 28. The aforementioned thrust bearing holds shaft 21 against axial movement in one direction, and axial movement thereof in the other direction is prevented by collar 29.

The rotor frame 20 is provided with a finished or machined peripheral face 30 which is opposite the aforementioned face 19 and cooperates therewith to form a seal between the rotor frame 20 and the stationary frame 15. While this seal will not normally prevent all flow of liquid into the sluice 12, it is preferably such that no particles can flow into said sluice 12 which could not flow through the screen as hereinafter described. Furthermore, by adjusting the rotor frame relative to frame 15, the effective size of this seal may be adjusted.

Mounted on the rotor frame 20 is a screen cloth 31 which is attached thereto by a ring 32 which is bolted to the frame 20 as clearly illustrated in Fig. 5 of the drawings as well as a plurality of radial plates 33 which are bolted to radial ribs 34 forming a part of the rotor frame 20. In place of the screen cloth 31 I may employ a perforated metal plate, and in some instances this has been found in practice to be preferred. It is of course evident that the rotary disk screen 14 will be operative to separate solid material above a predetermined size which reaches it, permitting only the liquid and small particles of solids to flow into the effluent sluice 12. This of course will produce a loss of head which accounts for the difference in water levels indicated by the lines 11 and 13.

To keep the screen cloth 31 from blinding or becoming stopped-up, I provide lower sprays 35 and upper sprays 36 which are situated on the effluent side of the screen 14 and at a position to spray steam, air or water over large areas of the screen cloth 31 after said screen cloth has emerged from the liquid in the tank 10. These sprays 35 and 36 are effective to remove solids and grease from the screen cloth 31 or the perforated screen plate.

An important feature of my invention is the construction and arrangement of the influent sluice by which the liquid bearing the solids is delivered to the tank 10 and to the screen 14. This sluice is in the form of a trough 37 which in general is made of concrete as a part of the tank 10 and sluice 12. The discharge portion of said sluice 37, however, is made of metal comprising two fixed side walls or plates 38, 38 and two adjustable side walls or plates 38', 38' and a bottom wall or plate comprising two sections 39, 39'. These side walls 38', 38' are each longitudinally adjustable toward and from the screen 14 by virtue of elongated slots 60, 60 therein through which bolts 61, 61 extend. This provides for an adjustable clearance between the front edges of side walls 38', 38' of the sluice 37 and the adjacent face of the screen 14.

The discharge portion of the sluice 37 being made of metal, also includes the stationary bottom plate 62 to which is hinged at 40 the transverse plate 39. The bottom plate section 39' rests on top of the section 39 as shown in Figs. 2 and 6 and is longitudinally adjustable toward and from the screen 14 by virtue of elongated slots 65 in the plate 39' and bolts 64 which extend through perforations in the plate 39 and through the slots 65 in the plate 39'.

Furthermore, to permit a free discharge of any unusually large material into the tank 10, the bottom plate 39, 39' is pivoted at 40 and is spring biased by spring means 41 to the normal position as illustrated in Fig. 2 of the drawings. Such spring means may be connected between the side plates 38, 38 and the ends of the bar 63 which is secured to the bottom of the plate 39.

It may be noted that the direction of rotation of the rotor frame 20 is clock-wise as illustrated by the arrow in Fig. 4 of the drawings. Consequently, if a large particle of material becomes lodged between the screen cloth 31 and the discharge edge of bottom plate or wall 39, 39', the rotation of the rotor frame 20 will carry this particle downwardly into the tank 10 while the plate 39, 39' swings to permit its discharge thereinto.

It is further of importance to notice the position and extent of the sluiceway 37 with respect to the screen 14. In the first place, it is to be noted that the lateral extent of the sluice 37 is between the shaft 21 and the peripheral portion of rotor frame 20.

Furthermore, there is an area of the screen cloth 31 which is radially beyond the outermost radial area of the sluice 37. This insures that the outer portion thereof will be clean when it dips below the liquid in tank 10 thereby insuring screening thereof, and in addition any liquid flowing through the sluice 37 will be discharged due to its velocity directly onto an area of the screen 14 which is covered by a screen cloth 31.

Furthermore, the direction of rotation of the rotor frame 20 is such that after the influent liquid strikes the screen cloth 31 substantially at right angles to its plane, the screen cloth moves

downwardly into the liquid in receptacle or tank 10 after which it moves out of the liquid and is cleaned by the lower and upper sprays 35 and 36, respectively.

It is to be particularly noted that full advantage is taken of the velocity of the influent liquid to effect a passage of the liquid through the screen cloth 31. It may be noted that the normal water level in the sluice 37 is indicated by the line 42.

As clearly illustrated by reference particularly to Fig. 1 of the drawings, the side walls of the receptacle or tank 10 converge so that settling solids will settle along a bottom which is in the form of an endless scraper conveyor 43 of special design for removing the settled solids with a minimum of liquid. The conveyor 43 comprises a trough having a material supporting bottom plate 44 and upwardly extending side plates 45 over which is adapted to move an endless conveyor mechanism comprising a pair of endless chains 46 which travel adjacent the side plates 45 and which are driven from head sprockets, one of which is diagrammatically illustrated at 47 in Fig. 3 of the drawings, which sprockets are keyed to head shaft 48 driven by an electric motor 49 through an appropriate drive mechanism 50, such as a chain and sprocket drive mechanism.

Adjacent the bottom of the conveyor 43 is a U-shaped guide 51 for each of the endless chains 46 which eliminates the necessity of tail sprockets and a tail shaft within the tank 10. It is of course evident that the conveyor 43 extends upwardly in a sloping manner in the tank 10 so that any solid material that settles on the bottom plate 44 will be conveyed upwardly by flights 52 which extend between the endless chains 46, the solid material thus removed from the tank 10 being discharged over the head shaft 48 onto a belt or screw conveyor 53 or any other receptacle. The flights 52 are preferably perforated as illustrated in Fig. 1 of the drawings to permit free flow of liquid through them thereby draining the solids of liquid as they are conveyed above the water level 11 in tank 10.

Furthermore, the bottom plate 44 is preferably perforated above the water level 11 as illustrated at 54 in Fig. 2 of the drawings to aid in this dewatering of the removed solids.

Still further, a pivoted top plate 55 is provided above the perforated portion 54 of bottom plate 44 which acts to squeeze or compress the solid material after it leaves the water in container 10 to aid in this dewatering process. It is to be noted that the bottom edge of the plate 55 is tapered as illustrated at 56 and this bottom edge is preferably slightly below the normal water level 11 in tank 10. This keeps material from falling off the flights 52 as they ascend above the water level 11. The floating scum is free to float along the passageway indicated by the line of the arrow 57 (see Fig. 1) along which it is effectively propelled by the clockwise rotation of rotor 20 over weir 58 formed at an elevation below the liquid level 11 between a wall of tank 10 and effluent flume 12. Said scum is conveyed from the tank 10 by the conveyor 43 along with the solids which settle in the bottom of said tank 10. At intervals it may be raked by a hand-operated scum rake into the path of the flights 52 of conveyor 43, while the top plate 55 is elevated, as by a chain 59.

In the operation of the device the sewage or waste liquid flows by way of influent sluice 37, the velocity of which is utilized to direct it

against the rotating frame 20 of rotary disk screen 14 which screens liquid permitting only a clean liquid and solid material of relatively small size to flow into the effluent sluice 12.

The screen rotor 20 is rotated at an adjustable speed by the motor 27 and drive mechanism operative thereby. The screen cloth 31 of the perforated plate is continually cleaned by the sprays 35 and 36 thereby insuring an efficient screening action at all times. Solids which cannot pass through the screen cloth 31 settle on the bottom plate 44 of the conveyor 43 and are removed while they are simultaneously dewatered and delivered to any desired receptacle, such as conveyor 53.

It is thus evident that a simple but highly efficient screening apparatus for screening sewage or slaughter-house or industrial wastes has been provided.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and I therefore wish not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention, what I desire to secure by Letters Patent of the United States is:

1. In screening apparatus, the combination with a sedimentation tank, of a sluice for directing influent into the upper portion of said tank, an effluent sluice in the upper portion of said tank having a closed end therein and being in position to be partially immersed in the liquid therein and having an opening through which liquid from said influent sluice flows thereto, a rotary screen positioned across said opening in said effluent sluice located adjacent said influent sluice and, mechanism supporting said rotary screen with its lower portion immersed in the liquid from said influent sluice flows thereto, non-immersed portion adjacent the outlet from said influent sluice, and means for rotating said screen while permitting the liquid and finer solids to pass through the same from said influent sluice into said effluent sluice, the screen being constructed and arranged to act as a baffle to deflect the larger solids into said sedimentation tank.

2. In screening apparatus, the combination with an effluent sluice, of a rotary screen extending across an opening in one side of said effluent sluice, an influent sluice with its outlet at one side of the center of rotation of said rotary screen, and means for rotating said screen downwardly past said outlet while the influent and finer particles of material pass through the screen into said effluent sluice, the screen being constructed and arranged to act as a baffle to deflect downwardly below said outlet the larger particles of material.

3. In screening apparatus, the combination with a sedimentation tank, of an effluent sluice having a closed end projecting into said tank but spaced from the adjacent inner wall thereof, a rotary screen extending across an opening in one side of said effluent sluice and acting as a baffle to large particles of material incapable of passing therethrough, mechanism supporting said rotary screen for immersion of its lower portion in the liquid in said sedimentation tank, a sluice for directing influent to said screen, and means including said screen, to produce a current of the surface liquid in said tank to flow unscreen-

able floating material around the closed end of said effluent sluice.

4. In screening apparatus, the combination with a sedimentation tank, of an effluent sluice having a closed end projecting into said tank, a weir spanning the space between the inner end of said sluice and the adjacent inner wall of said tank, a rotary screen extending across an opening in one side of said effluent sluice and acting as a baffle to large particles of material incapable of passing therethrough, mechanism supporting said rotary screen for immersion of its lower portion in the liquid in said sedimentation tank, a sluice for directing influent against one side of said screen for flow therethrough into said effluent sluice, and means, including said screen, to produce a current of the surface liquid in said tank to flow unscreenable floating material over said weir.

5. In liquid screening apparatus, the combination with a substantially vertical rotary disc screen, of an influent liquid conveying flume at substantially right angles to said screen, and an extension from said flume toward the adjacent face of screen adjustable to vary the spacing between the outlet from said extension and said screen face.

6. In screening apparatus, the combination with a rotary screen, of a sluice leading thereto but spaced therefrom, an adjustable extension from said sluice toward said screen, said sluice having a downwardly swingable spring biased bottom plate at said extension operable to permit discharge of relatively large pieces of material flowing from said sluice, and means for rotating said screen in a direction to swing such bottom plate downwardly when such relatively large pieces of material are being discharged from said sluice and are in contact with said screen.

7. In liquid treating apparatus, the combination with a receptacle for liquid having solids in suspension, of a trough having a perforated bottom, conveyor means movable over the perforated bottom of said trough, and means comprising a cover plate for squeezing material as it moves under said plate and out from the liquid in said receptacle to reduce its liquid content.

8. In liquid treating apparatus, the combination with a sedimentation tank, of conveyor mechanism for removing settled solids from the liquid in said tank, and means comprising a cover plate for squeezing material as it is moved under said plate and out from the liquid in the tank to reduce its liquid content.

9. In liquid treating apparatus, the combination with a sedimentation tank, of conveyor mechanism for removing sediment from the tank, and means comprising an upwardly yieldable cover plate for squeezing material as it is moved under the plate and out from the liquid in the tank to reduce the liquid content of such material.

10. In liquid treating apparatus, the combination with a sedimentation tank, of a trough having a perforated bottom extending upwardly out of the liquid in said tank, an endless conveyor means including perforated flights movable along said perforated bottom, and means comprising a pivoted cover plate for squeezing material as it moves under said plate and out of the liquid in said tank to reduce its liquid content.

11. In screening apparatus, the combination with a screen, of a sluice leading thereto having its discharge edges close to but slightly spaced from said screen, said sluice having a downwardly

swingable spring biased bottom plate operable to permit discharge of large particles between said screen and sluice edge, and means for rotating said screen in a direction to swing said bottom plate downwardly in case a large particle becomes lodged between the screen and swingable bottom plate.

12. In screening apparatus, the combination with a substantially vertical rotary disk screen, of means for rotating said screen on a substantially horizontal axis, a liquid receptacle into which the lower part of said screen projects below the liquid level, an effluent sluice leading from said receptacle from which liquid flows after passing through said screen, an influent sluice positioned to deliver flowing liquid having suspended solids therein substantially at right angles to the plane of said screen and directly onto it, said influent sluice extending laterally

between the axis of rotation of said screen and the periphery thereof, means on the opposite side of said screen from said influent sluice for flowing adhering solids from a portion of the screen while out of the liquid, and means for rotating said screen so that as it moves from said influent sluice it first moves down into the liquid in said receptacle and then out into the path of said flowing means.

13. In liquid treating apparatus, the combination with a receptacle for liquid having solids in suspension, of a conveyor for removing settled solids comprising a trough having a perforated bottom, endless conveyor means including perforated flights movable over said trough, and means comprising a cover plate for squeezing material as it moves out of the liquid in said receptacle to reduce its liquid content.

WILLIAM C. MOOR.

CERTIFICATE OF CORRECTION.

Patent No. 2,324,637

July 20, 1943.

WILLIAM C. MOOR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 37, for "theheto" read --thereto--; line 40, strike out the word "and" and insert the same after "sluice" in line 39; line 42, for "from said influent sluice flows thereto," read --in said sedimentation tank and with its--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 9th day of May, A. D. 1944.

(Seal)

Leslie Frazer
Acting Commissioner of Patents.