G. B. WELSER, JR.

LIQUID SCREENING APPARATUS.

APPLICATION FILED MAR. 25, 1919.

1,435,770.

Patented Nov. 14, 1922.

5 SHEETS—SHEET 1.

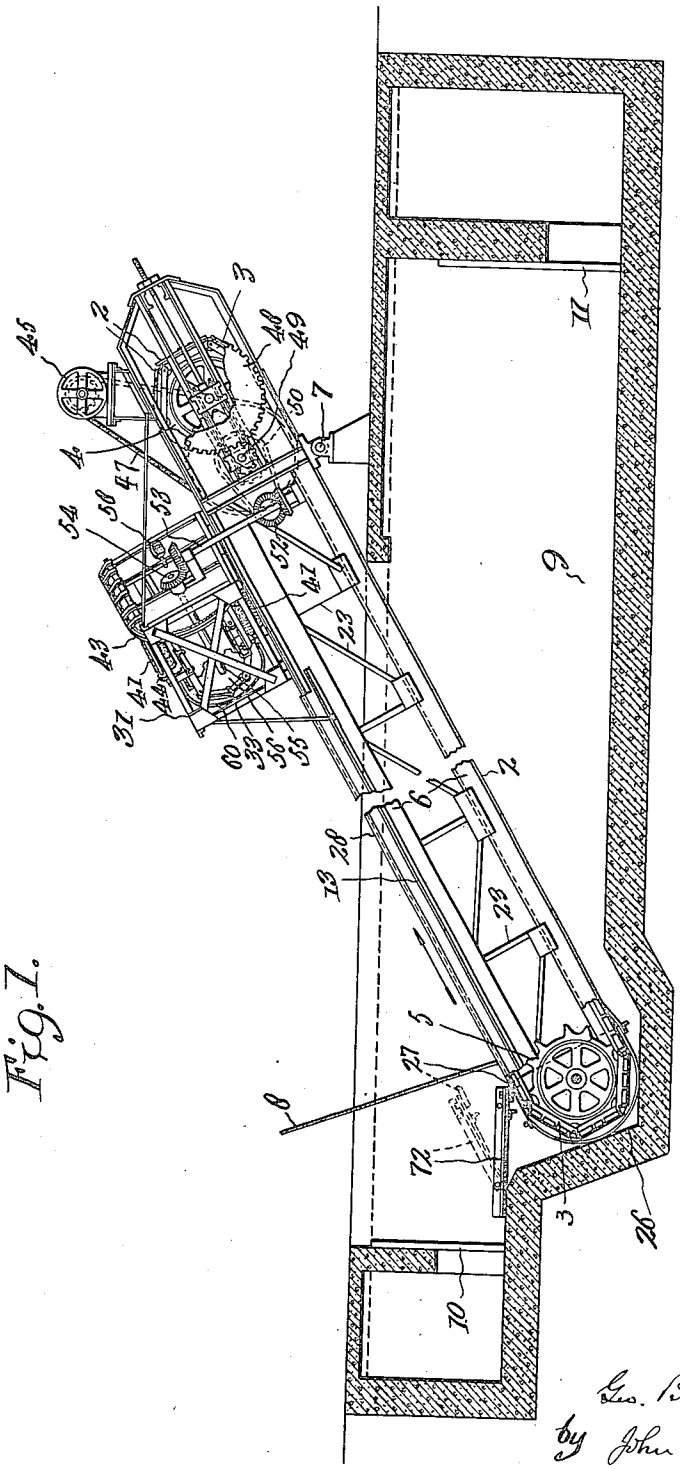


Fig. 1.

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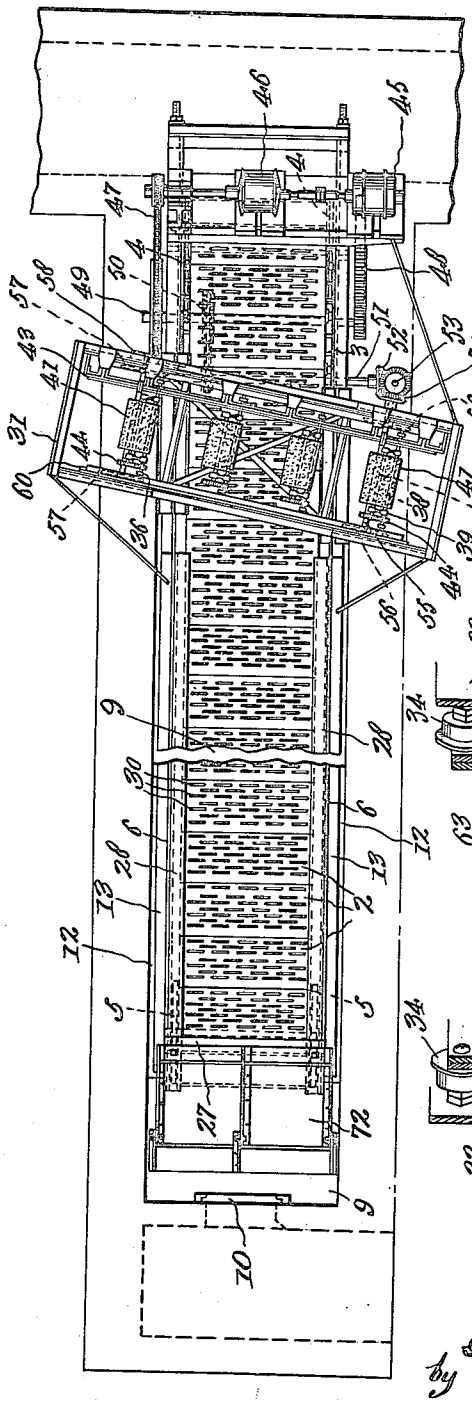


Fig. 2.

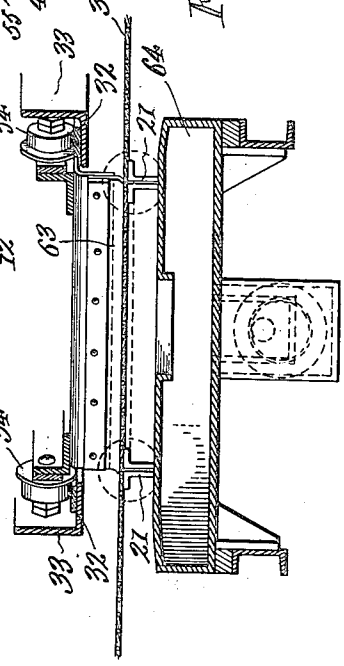


Fig. 9.

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5 SHEETS—SHEET 3.

Fig. 4.

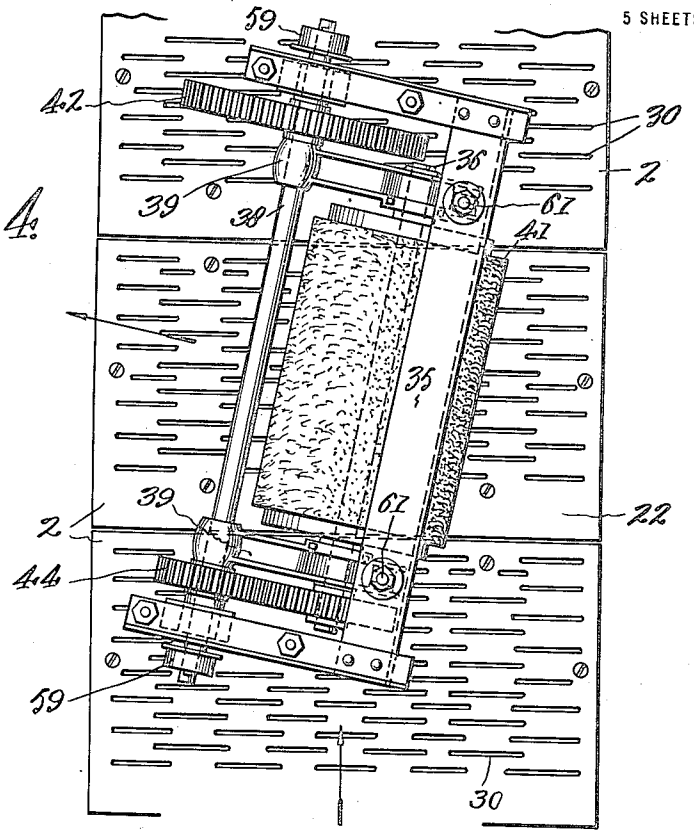
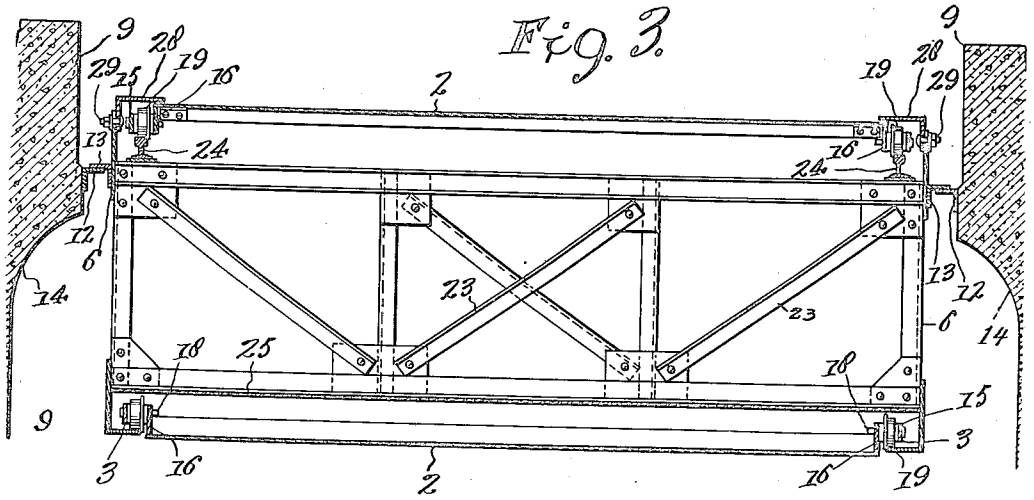


Fig. 3.



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5 SHEETS—SHEET 4.

Fig. 5

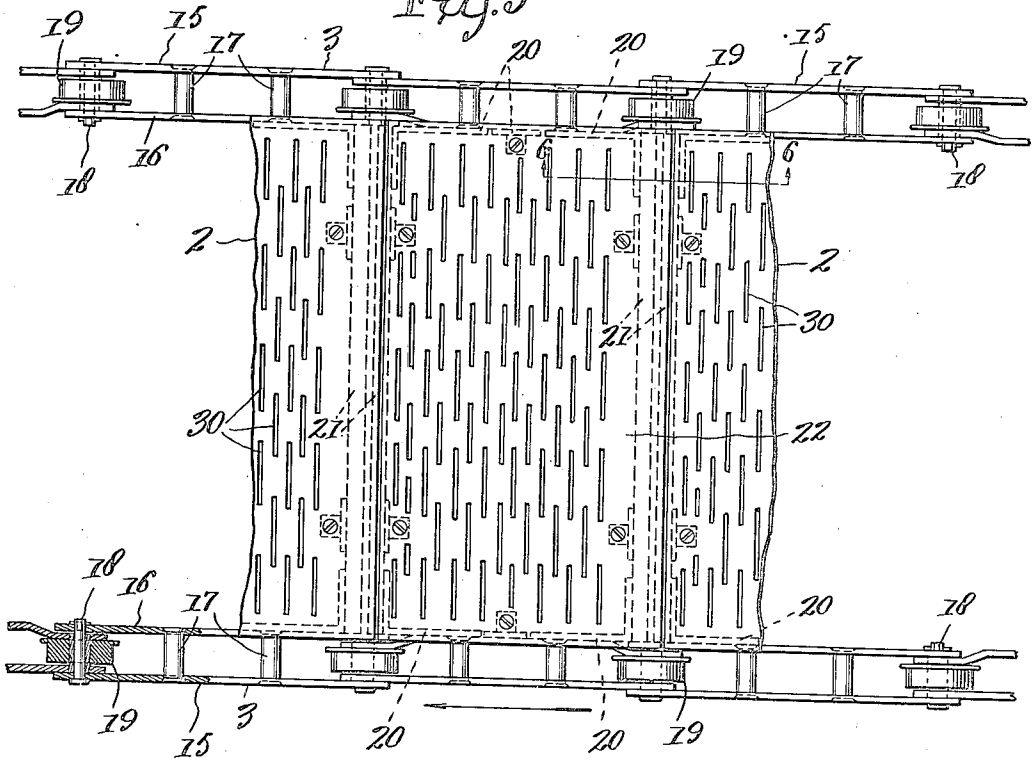
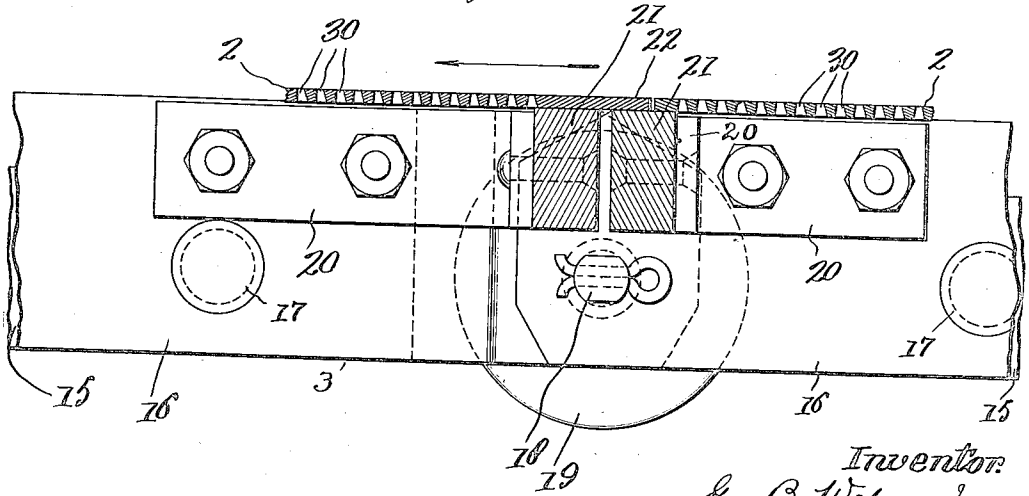


Fig. 6.



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5 SHEETS—SHEET 5.

Fig. 7.

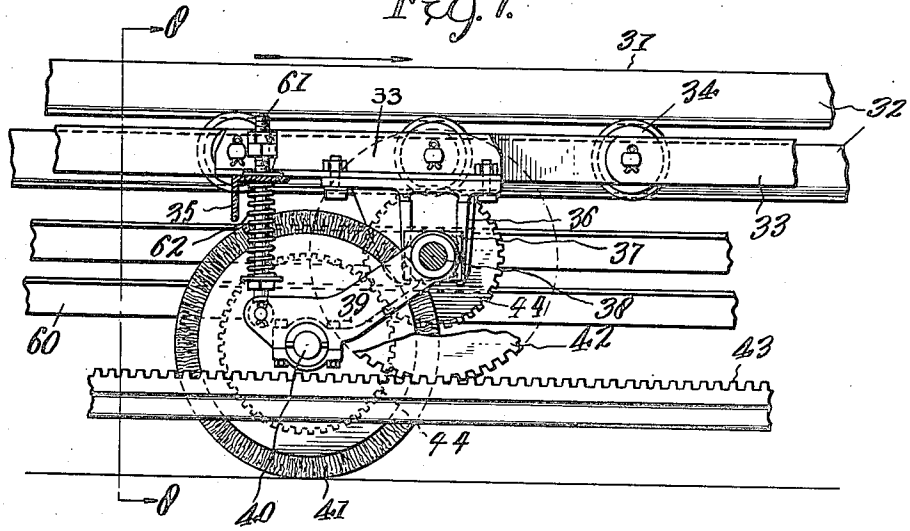
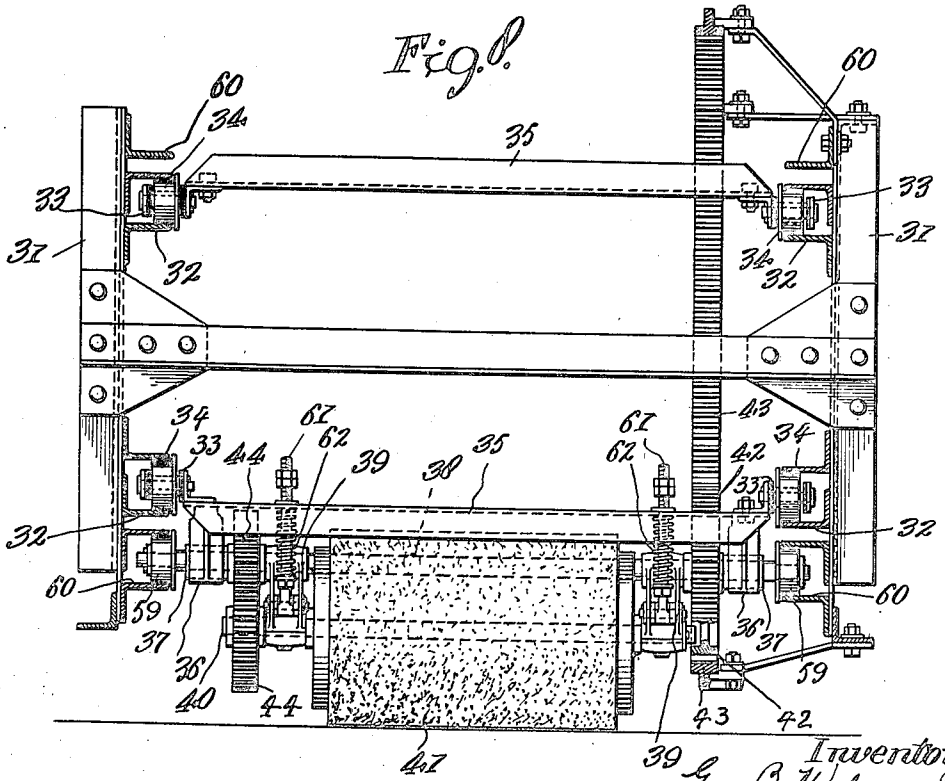


Fig. 8.



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UNITED STATES PATENT OFFICE.

GEORGE B. WELSER, JR., OF MILWAUKEE, WISCONSIN, ASSIGNOR TO CHAIN BELT COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

LIQUID-SCREENING APPARATUS.

Application filed March 25, 1919. Serial No. 284,926.

To all whom it may concern:

Be it known that I, GEORGE B. WELSER, Jr., a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Liquid-Screening Apparatus, of which the following is a specification.

This invention relates to apparatus for screening water to take therefrom the coarser solid material carried thereby, apparatus of this kind being used for the treatment of sewage, and for the screening of the water taken from flowing streams to be used for the making of steam or other industrial purposes. The invention has been developed with reference to apparatus of the endless, moving screen type, particularly where the screen is formed of a series of perforated metal plates supported by endless chains that travel around sprocket or other suitable supporting wheels, certain of which are driven.

In the accompanying drawings a preferred embodiment of the invention is illustrated without, however, intending thereby to limit the invention in its useful applications to the specific apparatus shown. In such drawings Fig. 1 is a longitudinal sectional view of a single screening unit, Fig. 2 is a top plan view thereof, Fig. 3 is a transverse section taken on the line III, III of Fig. 1.

Fig. 4 is a detail plan view of a short section of the travelling screen and one of the cleaning brushes with certain of the parts for supporting and driving the brush, the view indicating the relative directions in which these parts move.

Fig. 5 is a plan view of a section of the screen and the chains to which the screen plates are secured.

Fig. 6 is a longitudinal sectional view taken on the line 6—6 of Fig. 5.

Fig. 7 is a sectional elevation of the screen cleaning apparatus.

Fig. 8 is a transverse sectional view on the line 8—8 of Fig. 7.

Fig. 9 is a transverse sectional view through the screen cleaning mechanism illustrating a different form of the invention from that shown in the other views.

The screen proper consists of a series of perforated metal plates 2 supported by suitable endless chains 3 that travel in engagement with wheels 4 and 5. The screen is mounted in a frame consisting of side parts 6 suitably constructed to give the desired strength and preferably hinged at its upper or head end, as indicated at 7. Means are connected with the lower or foot end of the screen frame for adjusting it upon its hinge, such means being typified by the cable 8. The foot end of the screen is adapted to be lowered into a water chamber 9 through which passes the water or other liquid to be screened, the liquid entering through a suitably controlled gate 10, preferably located near the end of the chamber occupied by the foot of the screen, and passing out through an outflow gate 11. The screen is driven, preferably by mechanism that will be latter described in detail, so that the upper run thereof travels from the foot wheel 5 toward the head wheel 4, the screen plates 2 being in active use only while successively constituting the said upper run. When in use the screen occupies an inclined position, as represented in Fig. 1, so that the material collected upon its surface will rest thereon, and being thus held by the force of gravity, be conveyed, by the movement of the screen, to the place where it is to be removed.

The chamber 9 is divided along the line of travel of the upper run of the screen into two parts, one containing the unscreened water and the other the water that has passed through the screen and been cleansed. I prefer that this division should be effected by means of angle plates 12, secured to the side walls of the chamber 9, and other angle plates 13, carried by the side frame pieces 6 of the screen frame, the laterally projecting flanges of the angle plates 13 being adapted to overlie and rest upon the laterally projecting flanges of the angle plates 12 when the screen is let down into the chamber in working position. This is a simple and satisfactory arrangement for effecting the cut-off or division between the screened and unscreened bodies of liquid and does not in any way interfere with the free movements of the screen about its hinge 7. In a screen such as illustrated in this case where the mesh of the screening surfaces is fine it is very important that all openings in the working parts of the apparatus shall be kept as small as possible. Where the screen is carried in a pivoted frame that is adapted to be let down into

the chamber through which passes the liquid to be screened, it is practically impossible to secure the necessary close fit between the pivoted screen frame and the walls of the liquid chamber, where dependence is placed upon engagement of the screen frame, or some attachment thereof, with a concrete surface constituting a wall of the liquid chamber. It is practically impossible to produce and maintain in a chamber such as indicated at 9 in the drawings, a concrete wall with which the screen frame will have the necessarily close fit for practical work, if fine screening is to be accomplished. I have overcome this difficulty in the manner described, namely, by attaching to the side wall of the chamber 9 plates 12 with which engage other plates 13 carried by the screen frame. The plates 12 may be accurately placed and so embedded in the walls of the chamber that they produce and maintain exactly the desired surfaces for the engagement of plates 13 carried by the screen frame. The latter plates may be adjusted to accurately fit the stationary plates 12 and may have a sufficiently broad bearing engagement therewith to form an effective cut off dividing the chamber 9 in the manner set forth. I prefer that the side walls of the chamber 9 should flare outwardly just below the angle plates 12, as indicated at 14, to allow sufficient space for the free flow of the screened liquid.

While the supporting chains may be of any suitable construction, they are preferably formed as shown. They are of articulated links each composed of outer side bars 15, and inner, attachment side bars 16, the corresponding bars 15 and 16, which together constitute the longitudinal elements of a link, being united by rivets 17, and the separate links being connected by pintles 18, on which are supported rollers 19. The inner, attachment side bars are wider than the outer side bars 15, and have secured to them near their outer edges angle pieces 20 to certain of which the screen plates 2 are secured, and to others of which are secured cross bars 21 that extend across the screen and unite the opposite chains 3, one of these bars being at each end of each link. The ends of the screen plates 2 overlie the bars 21, on which they rest. The upper edges of the cross bars 21 and of the attachment side bars 16, of each link, should all be in the same plane so as to afford firm support for each screen plate all round near its edges. One end of each screen plate 2, the leading end thereof in the arrangement represented in Fig. 1, extends about half way across the bar 21 of the link to which the plate is secured; while the adjacent end of the next screen plate in advance extends entirely across its bar 21 and sufficiently far beyond to overlie the cross bar first referred to and so that its edge meets the leading edge of the plate first mentioned, as represented at 22. When the chains and screen plates are in alignment the edges of the screen plates closely abut and the joints between them are directly over a cross bar. This arrangement has been adopted to prevent material accumulating between the ends of the screen plates and between the screen plates and the cross bars or between the faces of adjacent cross bars.

By constructing the chains that support the screen plates 2 as has been described, that is to say, by having the edges of the inner side bars 16, upon which the plates directly rest, higher than the edges of the outer side bars 15, it is possible to employ comparatively large supporting rollers 19 and at the same time arrange the angle pieces 28 (to be presently described) so that they extend across the said rollers and come into close relationship with the upper faces of the screen plates at their edges, as indicated in Fig. 3. This would not be possible if the side bars were both of the same size as the outer side bar 15; and if they both were made of the same size as the inner side bar the chain would be undesirably heavy.

The side frame pieces 6 are suitably united and braced by cross frame parts 23, of any preferred construction, disposed between the upper and lower runs of the screen. The screen frame is provided with tracks or rails 24 on which travel the rollers 19 of the screen-carrying chains.

In order to prevent a flow through the screen plates from their inner or back sides while they move along their lower or down run, with the incident tendency for solid material to collect on the inner sides of the screen plates, a baffle plate 25, Fig. 3, is secured to the screen frame in position to have the screen plates travel close thereto along that portion of their down run where they are immersed in the liquid within the chamber 9.

In a fine screen it is essential that a relatively high velocity of flow through the chamber 9 be maintained to prevent the deposit and accumulation of material on the structural parts of the frame. In order to facilitate the proper deposit of material on the screen plates it is important that the flow be as little disturbed as possible by back flow, eddies, or surging of the liquid, as otherwise the screen will not operate under the most efficient conditions. It has been heretofore proposed to use a suction box to accomplish this desired result, but I have found it much cheaper in construction, and quite as efficient in operation, to employ the baffle plate 25. This insures a scouring action on the part of the fluid being treated and prevents accumulations of material,

which, if formed and allowed to remain, would interfere with the proper treatment of the sewage or other liquid passing through the chamber 9, a fault that is incident to the use of a suction box. As will be seen by reference to Fig. 3 there is ample space between the edges of the baffle plate and the side walls of the chamber 9 for the lateral flow of the screened water.

When the screen is let down into the chamber 9 and is in working position, its foot end lies in a pocket or depressed part of the chamber and preferably adjacent to a transverse wall 26. A removable, impervious plate, 72, extending from side to side of the chamber 9, and carrying at its forward edge a sealing piece 27, is supported by the wall 26, with the said sealing piece resting upon the upper surface of the screen. This seal or cut-off operates to prevent the liquid from flowing around the foot end of the screen or through the screen and between the plates thereof, as they pass the foot wheel 5. When the screen is to be lifted from the chamber 9 the plate carrying the seal 27 will be removed. Adjustable angle pieces 28 are secured to the side pieces of the screen frame adjacent to that portion of the upper run of the movable screen that lies within the chamber 9 when the screen is in working position; the free flanges of such angle pieces overlying the edges of the screen as represented in Fig. 3. These angle pieces should be adjusted so that the edges of the screen shall run as close to the said overlying flanges thereof as is practicable, and they serve to prevent material from flowing from above the screen around its edges and thus getting into the outflow current without first having passed through the screen. The plates are secured to the screen frame by bolts 29, and these pass through slots, formed either in the side frame pieces or the angle pieces 28, as may be preferred, to permit the desired adjustment.

As has been stated the screen is preferably formed of metal plates 2, and in these are cut slots 30 that preferably taper from the outer toward the back or inner surfaces and are arranged crosswise of the plates, that is with their longer dimensions transverse to the direction of travel of the screen.

To remove the material that accumulates upon the surface of the screen and to clean the slots 30 in the screen plates, a cleaning mechanism of novel construction has been devised which will now be described. 31 indicates a framework supported by the screen frame and extending transversely thereof. It carries tracks 32 for the wheels 34 of a pair of endless chains 33 that carry and move the screen-cleaning elements. Cross pieces 35 unite the opposite chains and hold them properly spaced apart, and also serve as bearings for certain adjustment bolts 61 that will be presently described. Housings or slide ways 36 are suitably secured to the chains 33 and in them are mounted bearings 37 for cross shafts 38. Upon each shaft 38 are mounted a pair of link bearings 39 in which is supported a shaft 40 carrying a cleaner brush 41.

To each shaft 38 is secured a gear wheel 42 that runs in mesh with a stationary rack 43, carried by the cleaner frame 31 and paralleling one of the tracks 32. The shaft 38, which is driven by the gear wheel 42, is in connection with and drives the brush 41, through a train of gearing 44. A bolt 61 is pivotally connected with the free end of each link bearing 39, its outer end being seated in a cross piece 35, and an expansion spring 62 surrounds the bolt having bearing at one end against the cross piece 35 and at the other acting on the bolt. These springs operate through the bolts 61 to hold the brush 41 against the surface of the screen with the desired force. Suitable adjusting nuts by means of which the tension of the springs 62 and the extent of movement of the bolts 61 are controlled are mounted on the bolts.

As the slots 30 in the screen plates are preferably arranged transversely at right angles to the direction of movement of the screen, it follows that the bristles of the brush will enter the slots and clean them, the best advantage, if the movements of the revolving brush relative to the screen are transverse to the latter, as this arrangement permits the bristles to freely enter and pass from the slots in the direction of their length. In order that the bristles shall enter the slots as just described there should be no longitudinal movement of cleaning brush and screen with reference to each other during the cleaning operation, and since the screen is in motion while being cleaned, there should be an advance of the brush as it passes across the screen cleaning the slots thereof corresponding to the advance of the screen itself, and this is preferably accomplished by causing the cleaning brushes to move obliquely across the screen. The obliquity of the path of the cleaning brushes is determined by the relative speeds of movement of the screen on the one hand and of the brushes on the other, it being desirable, in order to secure the best results, that the movement of the brushes in a transverse direction should be rapid as compared with its movement in the direction of the travel of the screen.

The driving mechanism for the apparatus is preferably carried by the screen frame, so that, considered as a whole, the apparatus is self-contained, and no adjustments are required whatever be the angle at which the screen frame may be set within the liquid chamber, or whatever be its adjustment, from normal working position to a

position with the screen entirely withdrawn from the liquid chamber. A convenient arrangement is shown and illustrated in the drawings; referring to which, 45 represents a motor mounted on a suitable support carried by the screen frame. The motor is connected, through a suitable speed reducing mechanism 46 and connecting gearing 47, 48, to the head wheel 4 of the screen and thus drives the latter. The train of gearing 47, 48 includes a counter shaft 49 that is connected, by gearing 50, with a shaft 51, connected, through beveled gearing 52, with a vertical shaft 53, which in turn is connected by beveled gearing 54 with a shaft 55 on which are the sprocket wheels 56 for the chains 33 of the cleaner. The sprocket wheels 57 at the end of the cleaner frame 31 opposite the driving sprocket wheels 56 are mounted on a shaft supported in adjustable bearings 58, so that proper tension may be maintained upon the chains 33.

The shafts 38, on which are supported the link bearings 39 for the brush shafts, are extended to afford bearings for wheels 59, running on tracks 60 that parallel the tracks 32 for the wheels of the cleaner drive chains 33. The rack 43 with which the gear wheels 42 on the shafts 38 mesh also parallels the tracks 32. It will be understood that the tracks 32 are not continued about the wheels 56 and 57 with which the chains 33 engage, since the chains are properly supported by the wheels as they turn about them; but the tracks 60 and the gear rack 43 are continued about the wheels and concentric therewith. That is to say, the portions of the tracks 60 and of the rack 43 adjacent to the adjustable wheels 57 are concentric therewith when such wheels occupy what may be termed their normal position. But as the chains stretch and wear in use and it becomes necessary to adjust the bearings for the shaft of the wheels 57, the contiguous portions of the track 60 and the rack 43 cease to be concentric, though the departure from concentricity will never be very great. In order to prevent binding, or undue strain upon parts of the mechanism, and the separation of the gear wheels 42 from the racks 43, when the brushes 41 pass the wheels 57, whatever be the adjustment of the latter, the bearings 37 for the shaft 38—the wheels of which run in engagement with the track 60—are mounted in the slide ways or housings 36, and the outer ends of the link bearings 39 carrying the brushes and brush shafts are supported by the adjustment bolts 61 through which act the spring 62. This method of adjustably supporting the brushes permits the parts to automatically accommodate themselves and to travel in proper working relationships under the various conditions of adjustment that have been referred to, including passing the wheels 57.

The operation of the apparatus may now be understood. The motor drives the screen at a slow speed, about five feet per minute being a fair average speed. As the screen on its up run moves through the chamber 9 the liquid passes through it from the unscreened body of liquid above the cut-off plates 12, 13 to the screened body of liquid below, leaving the coarser solid material upon the outer surfaces of the screen plates. A reverse flow of the liquid through the screen along the down run thereof is prevented by the baffle plate 25, as has been described; and the various cut-off means that have been described prevent flow of liquid carrying solid material that could be taken out by the screen past and around the portion of the screen in active operation. As the screen passes above the surface of liquid in the chamber 9 the solid material taken out thereby remains on the surface of the plates, and more or less of the liquid drains therefrom returning to the chamber 9, as the screen approaches the cleaning mechanism. Here the accumulated solid material is removed by the brushes, which are caused, by the chains 33, to move transversely across the screen, and are at the same time revolved, by engagement of the wheels 42 with the rack 43. The angle at which the cleaning frame 31 is set with reference to the screen frame is slight, and the speed ratios of the screen and the cleaning devices are such that the brushes travel across the screen rapidly as compared with the advancing movement of the screen, and the speed of revolution of the brushes is also relatively rapid. This arrangement of parts and method of operation causes the material to be removed from the surfaces of the screen plates, and the slots in the latter to be brushed out and thoroughly cleansed, the latter operation being facilitated by insuring that the brush advances in the direction of the movement of the screen at the same speed as does the latter, at the same time that it is traveling across the screen and revolving, as has been pointed out.

The same efficient cleaning of the slots in the screen plates might be attained by disposing the slots at a proper angle relative to the direction of movement of the screen and causing the brushes to travel across the screen surface in a direction at right angles to the movement of the latter, although the arrangement shown is preferred.

While a rotary brush is the preferred means for cleaning the screen, nonrotating brushes 63, Fig. 9, might be used in place of the rotary brushes, such brushes being provided either with bristles or with non-bristle wiping edges. In such form of cleaner the relative movements of screen and cleaning mechanism, to insure the thorough cleansing of the slots of the screen that has been al-

ready described in detail, should be maintained. When using a non-rotating brush particularly of the wiper form it is sometimes found desirable to provide for forcing air under more or less pressure through the screen as it is being cleansed, and in Fig. 9 there is represented a wind box or chest 64 over which the screen passes while being acted upon by the cleaner. The joint action of the air under pressure and the cleaner effectively removes the material collected not only from the surface of the screen plates but from the walls of the slots 30 therein. The air cleaning adjunct just referred to could be used with the rotating brush cleaner arrangement described and illustrated, by locating a wind box in the same relationship as represented in Fig. 9.

Any suitable means for supplying air under pressure to the wind box or chest 64 may be employed, it being thought unnecessary to further illustrate this fixture.

What I claim is:

1. In a liquid screening apparatus, the combination of a chamber through which the liquid in the screen flows, an endless traveling inclined screen, the lower portion of which extends into said chamber, and the uprun of which screen is the working portion thereof, of a width approximating that of the chamber, flanges between the screen and the walls of the chamber dividing the chamber into two sections in one of which is the unscreened liquid and in the other the screened liquid, and a baffle plate adjacent to the downrun of the screen, there being open spaces at the sides of the screen above the baffle for the lateral flow of the screened water.

2. In a liquid screening apparatus, the combination with a chamber through which the liquid flows, an endless traveling screen having a lower run and an upper run, the latter serving as the screening surface, and there being an open space at one side at least between the said lower run and the side wall of the chamber for the free passage of the screened liquid, and a baffle plate between the runs of the screen arranged to divert the flow of liquid toward the side of the screen through the said free passage.

3. In a liquid screening apparatus, the combination with an endless screen comprising carrying chains and screen sections supported thereby, head and foot wheels around which the chains pass, a supporting frame for the screen, adapted to be immersed in the liquid to be screened, the frame having side pieces disposed outside the screen, and means for driving the screen so that the upmoving run thereof constitutes the working portion of the screen, of angle pieces supported by the side pieces of the screen frame, the free flanges of the angle pieces overlying the edges of the screen plates through the extent of the working portion of the upmoving run thereof, and means for adjustably connecting the angle pieces with the side frames to permit the flanges to be brought close to the edges of the screen in order to prevent solid material passing around the edges of the screen.

4. A screen for cleaning sewage and the like comprising a series of perforated screening plates and chains supporting the plates at their edges the chains being formed of articulated links, each comprising outer side bars and inner bars to which the plates are attached, the inner bars being wider than the outer bars and the screen plates resting upon the outer edges of the inner bars in a plane above the outer edges of the outer bars.

5. A screen for treating sewage and the like such as described in claim 4 having cross bars uniting the inner side bars, the upper edges of the cross bars being in the same plane as the upper edges of the inner side bars, and the ends of the screen plates resting upon the cross bars.

6. A screen such as described in claim 5 having the screen plates of such length that under working conditions the plates abut edge to edge, and so secured to the chains that one edge of each plate projects partially across the cross bar at one end of the link to which the plate is united while its opposite end extends entirely across the cross bar at the other end of the link and sufficiently beyond to overlie the cross bar of the adjacent link and meet the edge of the screen plate that partially crosses such latter bar.

7. A screening apparatus for sewage and the like comprising a series of perforated screens, and a pair of parallel chains carrying and supporting the screens, the chains being formed of articulated links having side bars on the edges of which the screens rest, and cross bars connecting the inner side bars of the two chains, and serving as intermediate supports for the screens.

8. A screening apparatus for cleaning sewage such as described in claim 6, in which the cross bars therein mentioned are vertically stiff, thus preventing sagging of the individual screens at their central portions, and giving stiffness to the conveyor formed by the connected parallel chains.

9. The combination with a longitudinally movable screen having a slotted surface, of a cleaner for the screen while it is in motion comprising a brush device for removing material that accumulates on the screen surface and also cleans the slots thereof and means for causing the brush device to move lengthwise of the slots and parallel therewith at the same time it moves transversely across the screen.

10. The combination with a longitudinally

movable screen having a slotted surface, of a cleaner therefor consisting of a brush device, means for moving the brush device transversely across the screen surface at a relatively rapid rate as compared with the longitudinal movement of the screen and for causing the brush device to move longitudinally along the slots over which it passes and substantially parallel therewith as it is being moved across the screen.

11. The combination with a longitudinally movable water screen having a slotted surface and means for moving the screen along straight lines longitudinally, of a cleaner for the screen consisting of a brushing device for removing the material from the slots in the screen, means for moving the cleaning device obliquely across the surface of the screen, and driving gearing for the means that move the cleaning device arranged to cause the cleaning device to move at such speed that as it travels across the face of the screen it also has a progressive movement in the direction in which the screen is moving and at a rate corresponding with the screen, substantially as and for the purposes set forth.

12. The combination of an endless screen adapted to treat sewage and like liquid, a frame supporting the screen, an endless cleaner for removing the material collected by the screen comprising a frame arranged transverse to the screen frame wheels supported at the ends of the cleaner frame, the wheels at one end being adjustable, endless chains mounted upon the wheels in the cleaner frame, tracks on which the chains run between the wheels, cleaning brushes adapted to move across the screen and remove the accumulated material therefrom, connections between the brushes and the chains comprising movable bearings for the brush supports, shafts mounted in the said bearings, gear wheels on the said shafts in driving connection with the brushes, a stationary rack with which the said gear wheels engage, tracks for supporting and guiding the ends of the shafts mounted in the said movable bearings, and springs for holding the brushes yieldingly toward the surface they are to clean, the said movable supports for the brushes permitting them to pass about the wheels at ends of the frame without strain of parts or disengagement between the stationary rack and the gear wheels meshing therewith under various conditions of adjustment of the chain supporting wheels necessary to maintain the chains under proper tension.

13. The combination with a movable screen adapted to treat sewage of a cleaner therefor consisting of brushing devices movable transversely across the screen surface and an air chest for receiving air under pressure located on the side of the screen opposite the cleaning device.

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