May 30, 1939. R. E. BRIGGS 2,160,535

CONVEYER

Original Filed Dec. 8, 1933 6 Sheets-Sheet 1

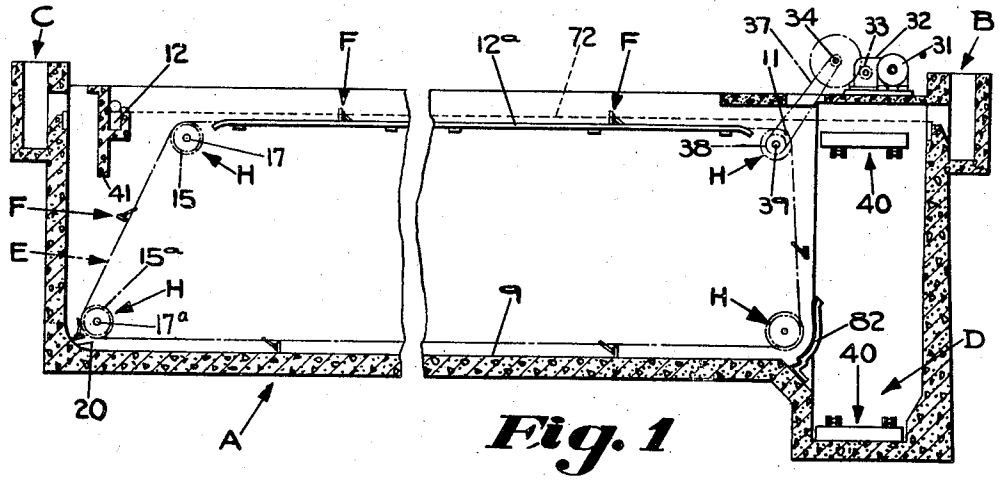


Fig. 1

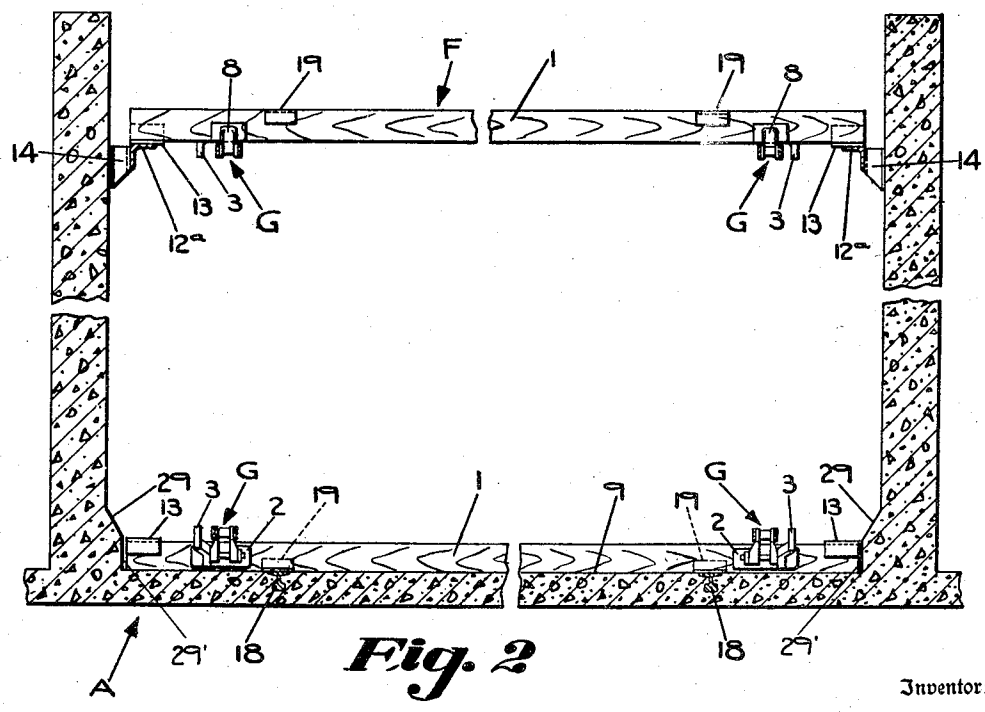


Fig. 2

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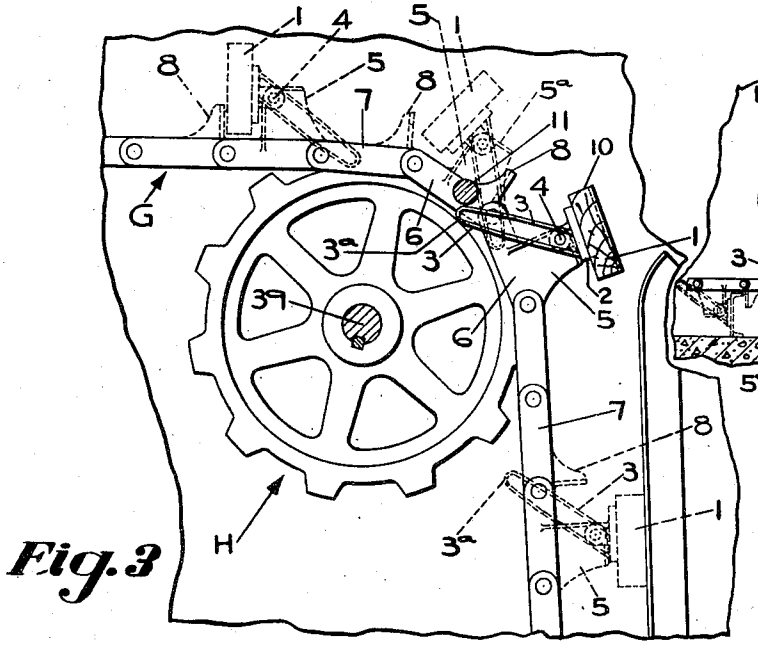


Fig. 3

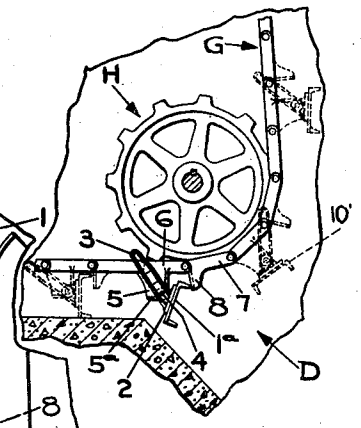
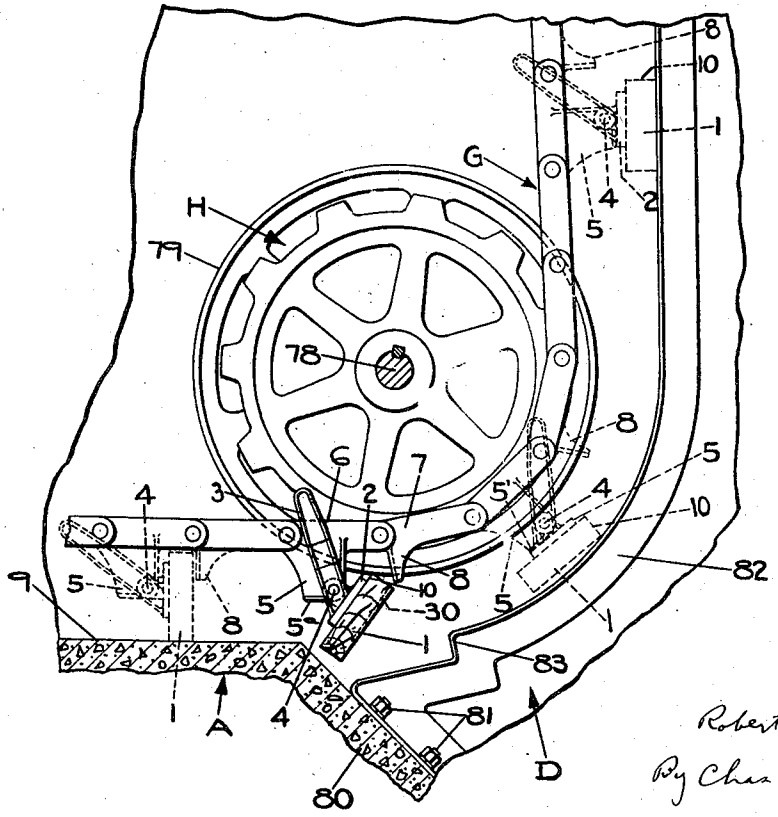


Fig. 16



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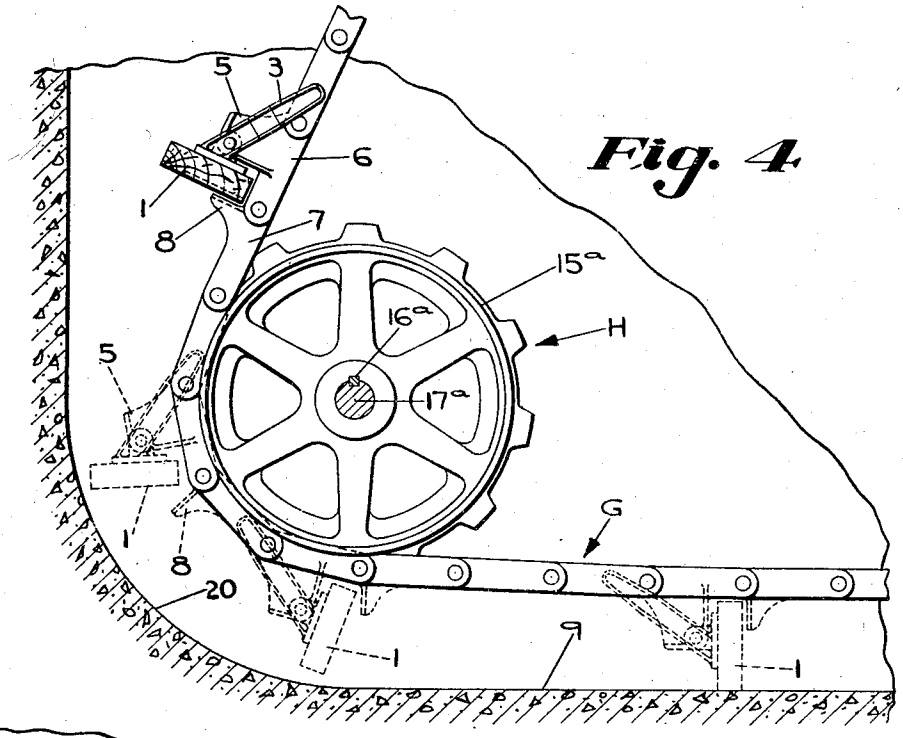


Fig. 4

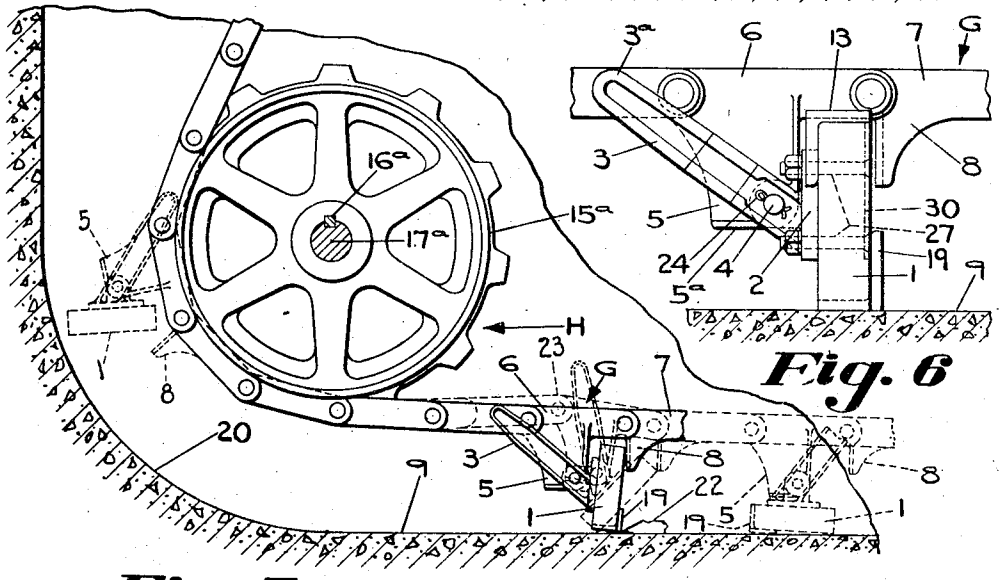


Fig. 6

Fig. 5

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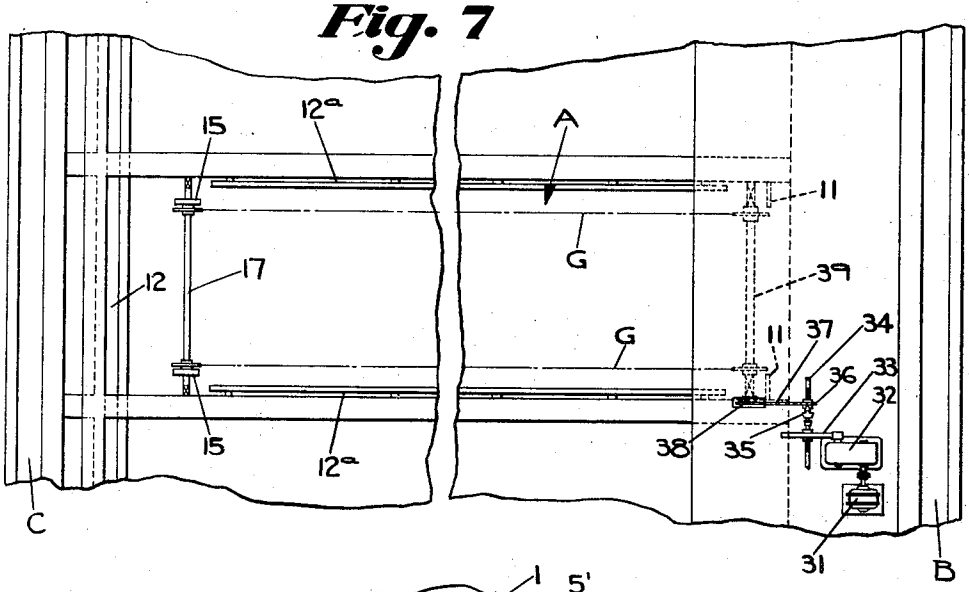
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Fig. 7



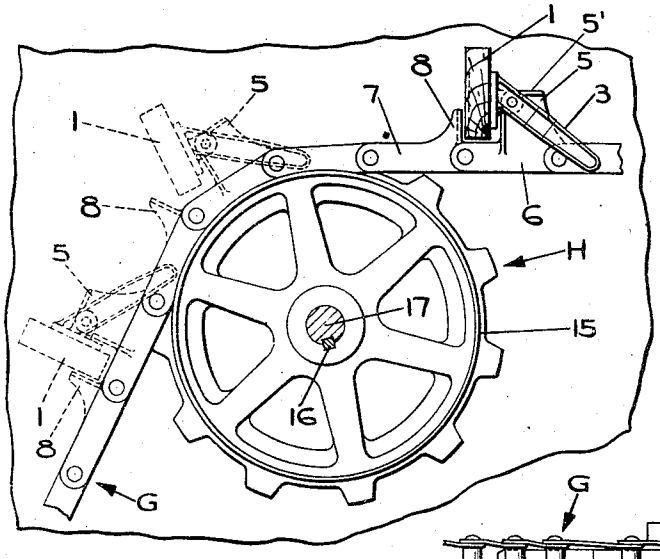


Fig. 8

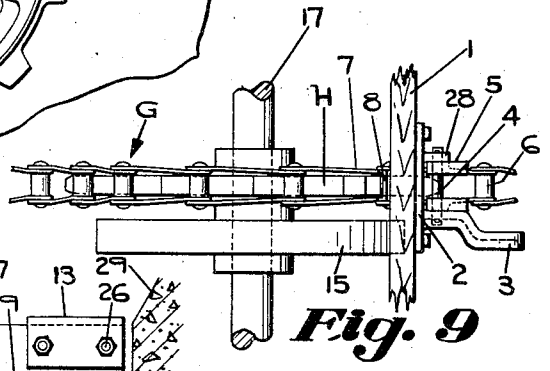


Fig. 9

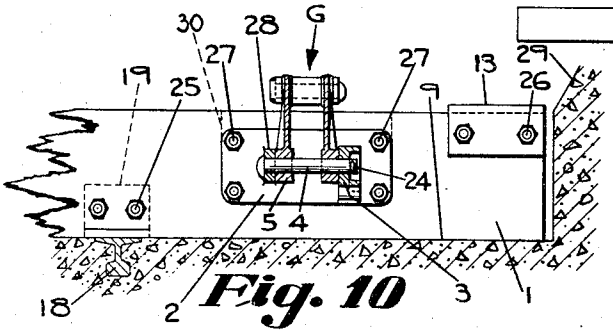


Fig. 10

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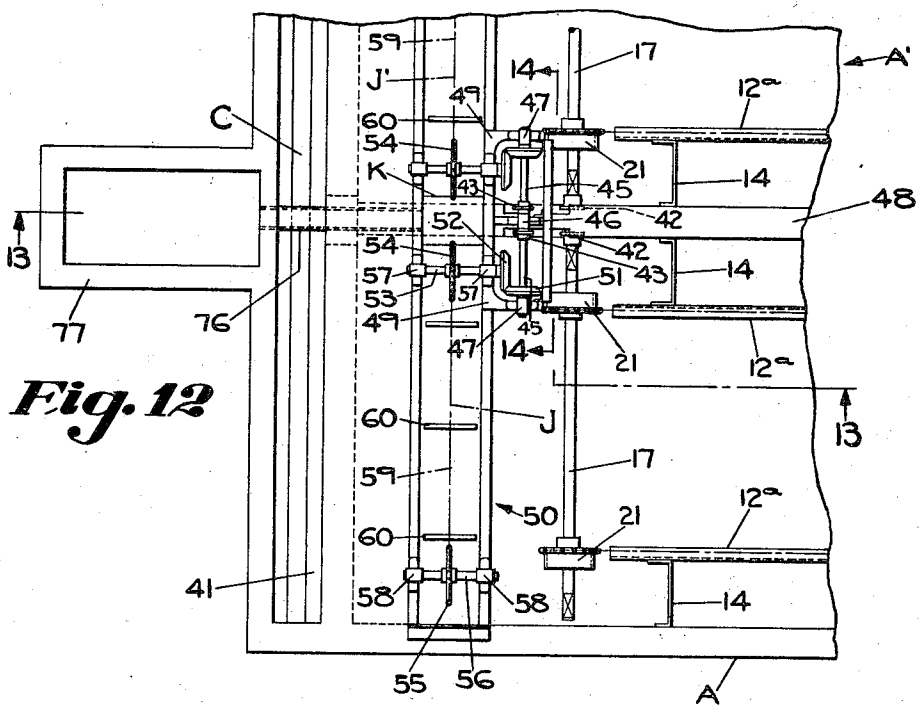


Fig. 12

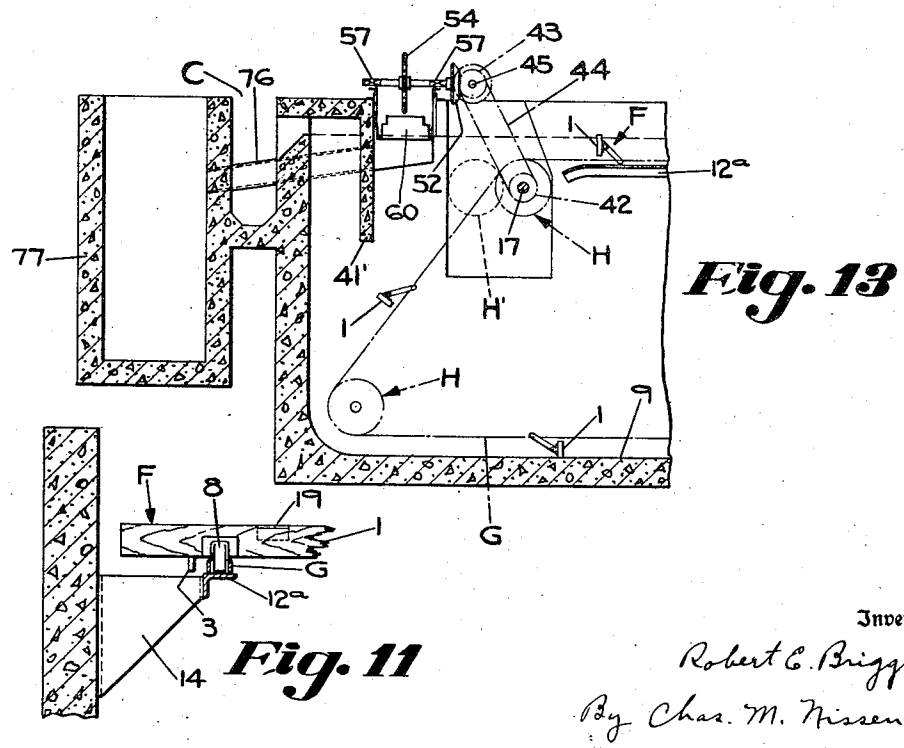


Fig. 13

Fig. 11

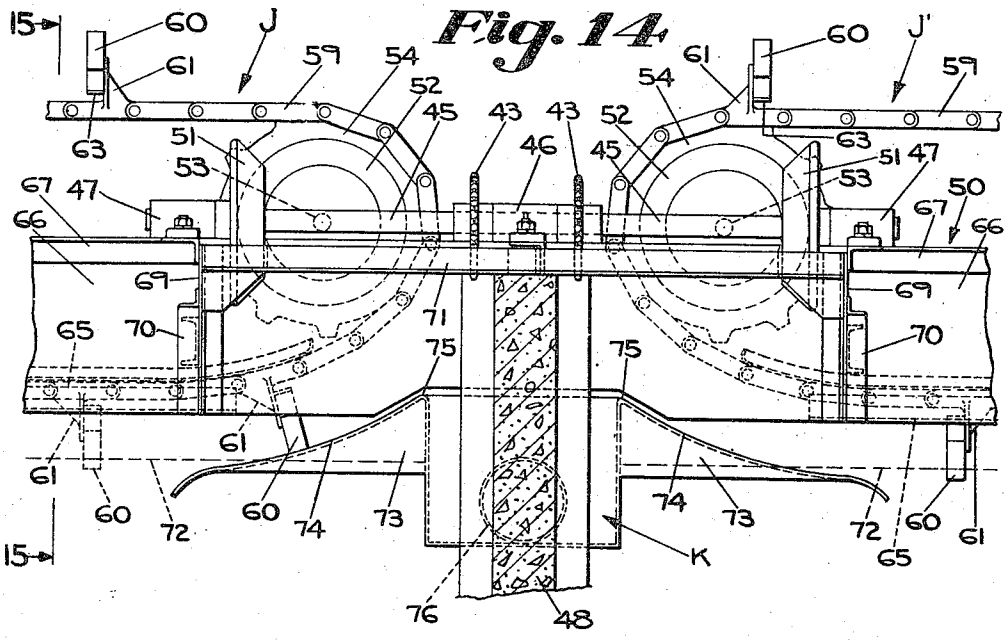
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Fig. 14.



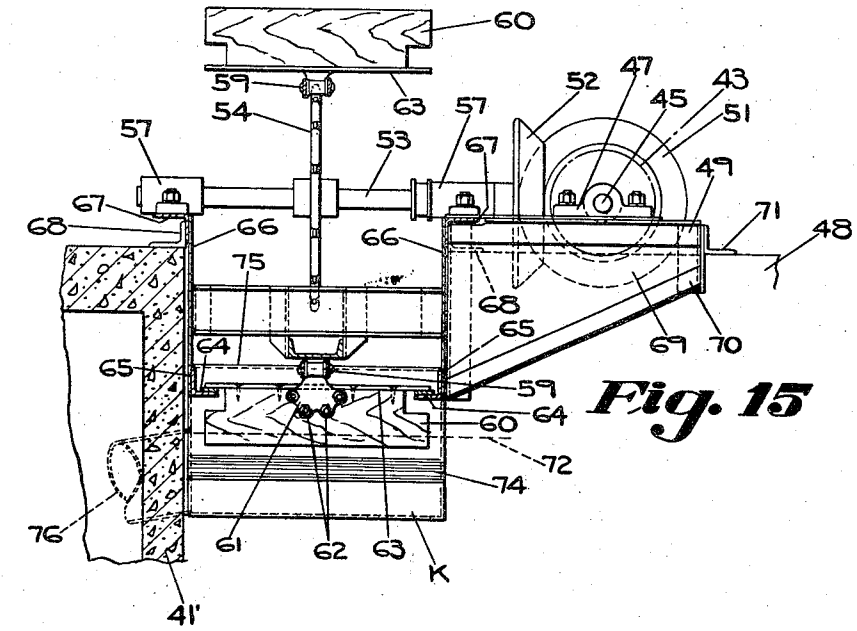


Fig. 15

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Patented May 30, 1939 2,160,535

UNITED STATES PATENT OFFICE

2,160,535

CONVEYER

Robert E. Briggs, Columbus, Ohio, assignor to The Jeffrey Manufacturing Company, a corporation of Ohio

Original application December 8, 1933, Serial No. 701,549. Divided and this application December 9, 1937, Serial No. 178,924

19 Claims. (Cl. 210—3)

The present invention relates to apparatus for removing settled solids from liquids, and although it is particularly adapted for use in sewage disposal plants, it may have a general application.

One of the objects of this invention is the provision of mechanism for automatically changing the positions of conveyer flights of a conveyer to act as collectors, carriers, scrapers and pushers in a sedimentation tank, containing liquids with solids in suspension, with a minimum disturbance of the liquids when moving upwardly through the same.

Another object of the invention is to provide improved mechanism for controlling the positions of conveyer flights so as to enable them to be moved with a minimum amount of disturbance to various depths of the liquid in a tank, such as a sedimentation tank employed in sewage disposal installations.

More particularly it is the object of the present invention to provide mechanism for automatically shifting the positions of flights of a conveyer relative to the draft means so as to reduce to a minimum disturbance of the liquid while the flights are being moved from their scraping positions at the bottom of a sedimentation tank to scum removing positions at the upper surface of the liquid in the tank.

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 longitudinal sectional elevation of apparatus adapted to remove solids from liquids and embodying the present improvements;

Fig. 2 is a transverse sectional elevation of the structure shown in Fig. 1;

Fig. 3 is a detail fragmentary elevation illustrating the position taken by the flights when rising through the sedimentation tank and illustrating one form of mechanism for transferring these flights from operative to inoperative position, and again into operative position;

Fig. 4 is an enlarged fragmentary sectional elevation showing the position of the flights on their descent through the sedimentation tank and their return into scraping engagement with the bottom of the tank;

Fig. 5 is a fragmentary sectional view illustrating the movement of a flight and chain incident to the flight engaging an obstruction in the bottom of the tank;

Fig. 6 is an enlarged elevational view showing the means for securing the flights of Fig. 4 in operative position as the flights move along the bottom of the tank;

Fig. 7 is a fragmentary plan view of a sedimentation tank provided with the improved conveyer;

Fig. 8 is an enlarged elevational view illustrating the position of the flights as they begin their descent through the sedimentation tank;

Fig. 9 is a fragmentary plan view of the parts shown in Fig. 8;

Fig. 10 is a fragmentary view of the rear right-hand end of the lower flight as viewed in Fig. 2;

Fig. 11 is a fragmentary view of one end of the flight during its upper course of travel through the tank, the view illustrating another form of supporting runway for the conveyer chains for preventing sag in the chains;

Fig. 12 is a plan view of the effluent end of two adjacent tanks provided with the improved conveyer, the view illustrating cross conveying means for removing scum or other material floating on the surface and collected by the longitudinal conveyer;

Fig. 13 is a sectional view, somewhat diagrammatic in character, taken on the line 13—13 of Fig. 12 looking in the direction of the arrows;

Fig. 14 is a sectional view illustrating further details of the cross conveyers, the view being taken on the line 14—14 of Fig. 12 looking in the direction of the arrows;

Fig. 15 is a further sectional view, taken on the line 15—15 of Fig. 14 looking in the direction of the arrows; and

Fig. 16 is a fragmentary view of the lower corner of the tank, as viewed in Fig. 3, showing the construction when steel flights are employed.

This application is a division of my co-pending application, Serial No. 701,549, filed December 8, 1933, on an Improvement in conveyers.

Referring more particularly to the drawings, the sedimentation tank is indicated generally at A, the tank being shown as formed of concrete, the liquid carrying the suspended solids entering at the influent end B, and flowing out from the tank at the effluent end C. At the influent end of the tank there is provided a sump D, for the preliminary collection of settled solid matter.

Since the incoming material to be treated usually contains relatively light and finely divided solid matter of a flocculant character, a rapid sedimentation will not be possible and therefore the suspended solids will be carried by the slowly flowing liquid beyond the sump D and toward the left as viewed in Fig. 1, for guiding the settling of such suspended solids along the bottom 9 throughout the extent of the sedimentation tank A.

In order to collect the settled solid matter from the bottom 9 of the tank A into the sump D, there is provided within the tank A a slowly moving conveyer E, preferably of an endless type, which conveyer comprises a plurality of spaced-apart flights F adapted to travel through the liquid along the bottom line of the tank A, as shown in Fig. 1.

As shown in Fig. 2, the flights F extend transversely of the tank A, the full width thereof at the bottom, and nearly the full width thereof at the upper portion of the tank. The flights F are connected near their outer ends to spaced-apart endless sprocket chains G which are driven and guided by the sprocket wheels H positioned generally in the upper and lower corners of the tank A, as shown in Fig. 1.

In addition to flocculent solids of only slightly higher specific gravity than the liquid medium in which they are suspended, the flowing stream being treated with sewage, the liquid frequently contains materials of a fibrous and putrescible character, which tends to cling to the flights and be carried thereon from one end of the tank to the other and back again. For preventing this action and to reduce the stirring action of the flights to a minimum, certain improvements have been embodied in the structure of the conveyer, which improvements will now be explained in detail.

It will be observed from the drawings that the flights comprise elongated bars 1, of wood as shown in Fig. 2, or 1ª of steel, as shown in Fig. 16. Wood, however, is preferred because of its buoyancy and resistance to the action of the liquid in the tank. The buoyancy of wood flights is such that friction between the flights and the bottom of the tank is vertually eliminated, the flights being held down by the weight of the chains and the metal wearing plates hereinafter described, just sufficiently to secure the desired scraping action along the bottom of the tank.

Secured to the rear surface of each flight are spaced-apart castings 2 each of which includes an elongated arm 3 positioned at a suitable angle to the flight 1. Each elongated arm 3 is pivotally connected at 4 to lugs 5 which project or extend from certain links of the sprocket chain G. The flights 1 may be of any suitable number and positioned at suitable intervals along the chains G.

It will also be noted that the links 7 next adjacent the projecting-lug carrying links 6 and in advance thereof, are provided with abutments 8, these abutments being spaced a sufficient distance in advance of the lugs or extensions 5 to form an opening to receive the flights 1, as shown in Fig. 8. The lugs 5 and 8 on the next adjacent links 6 and 7 form rear and front abutments for the flights 1 as the conveyer moves along the sedimentation tank during the upper scum removing run as well as the lower sludge removing run.

By referring to Figs. 3 and 16, it will be seen that the wooden flights 1 or the steel flights 1ª are adapted to scrape along the bottom 9 of the tank A, thereby pushing the settled solid or sediment along the bottom toward and into the sump D. The abutments 5 serve as pivotal supports for the flights 1 or 1ª, and when the lower edges of the flights 1 or 1ª engage the bottom of the tank, the flights tend to rotate on the axis of the pivot 4 in a clockwise direction as viewed in Fig. 3 or Fig. 16. This tendency of the flights to rotate is resisted by the abutments 8, so that the flights 1 or 1ª are confined to vertical positions when moving along the bottom of the tank. The front faces of the flights will thus be maintained in substantial vertical planes for action on the settled solid materials or sludge at the bottom 9 of the tank.

It will also be seen by referring to Figs. 3 and 16 that as the chains pass around the lower sprockets H, the abutments 8 and 5 spread apart, thereby releasing the flights 1 or 1ª and allowing the flights to be moved to inclined positions as shown in full lines at the lower portions of Figs. 3 and 16. This automatic movement of the flights to such inclined positions exerts an additional push on the sediment as the latter reaches the sump D, so that this sediment will more readily fall into the sump.

As the conveyer flights 1ª advance toward their vertical path of travel their weight causes them to swing about the pivots 4 so as to present the upper edge faces 10' to the suspended materials in the tank. Each lug or extension 5 is provided with an abutment surface 5ª occupying a position parallel to the path of travel of the chain on which the lug or extension 5 is mounted. When the flight 1 reaches its lower dotted line position the rear face 5' of the casting 5 engages the abutment surface 5ª and remains in engagement therewith while the flights are moving upwardly through the liquid in the tank. The turning movement of the flight 1 from its upright position shown in dotted lines at the lower portion of Fig. 16 or Fig. 3 to its inclined dotted line position shown at the lower portion of the same view, serves to dislodge substantially all of any sediment and fibrous material clinging to the flights.

Very frequently, especially in the treatment or handling of sewage, the solid materials in suspension are so light and flocculent and settle with such a degree of slowness that there may be comparatively large amounts of such materials floating at or near the surface of the liquid as the conveyer moves along its upper run. In order to collect such floating material, the flights are again automatically turned into operative position as the conveyer assumes a horizontal direction of travel. In order to effect this turning, there are provided stationary pins or similar abutment members 11, which extend inwardly from the side walls of the tank in position to be engaged by the rounded ends 3ª of the arms 3, as shown in Figs. 3 and 7. As the conveyer chains move upwardly around the upper sprockets H of Fig. 3, the engagement of the arms 3 with the stationary abutments 11 effects movement of the flight 1 from its full line position to its inclined dotted line position. The flight 1 is thus automatically turned on the pivot 4 in an anti-clockwise direction away from the abutment face 5ª into the space between the front face of the lug or extension 5 and the rear face of the lug 8 on the next adjacent link 7 in advance of the link 6. Therefore, as the conveyer chains pass around the upper right-hand sprockets H as viewed in Figs. 1 and 3, the flights will be tipped upside down so that each flight will be again in operative position between the lugs 5 and 8 for pushing floating material along the upper surface of the liquid in the tank and along through the liquid, to effect a banking of the collected floating material at a sump 12 adjacent the discharge or effluent end of the tank A.

During the upper run of the flight conveyer the chains remain submerged beneath the upper surface of the liquid indicated by the horizontal dotted line 72, but the flights F project through the upper surface 72 of the liquid in the tank. Scum and floating solids are thereby skimmed off and conveyed by the flights to the sump 12, where the floating materials are banked by the operation of the upper run of the flight conveyer. The opening of the sump 12 being above the liquid level 72 in the tank, the floating materials thus collected and banked may be removed by

manually raking them into the sump; or the sump may be replaced by conveyer mechanism of the type illustrated in Figs. 12 to 15, inclusive, which will be described in detail hereinafter.

For supporting the flights 1 for their upper run, the inner walls of the tank A are provided with supporting rails 12a the upper surfaces of which are adapted to be engaged by the lower outer ends of the flights 1. Such lower outer ends may be provided with renewable wear plates or shoes 13 of metal for protecting the wood of the flights 1 from wear as they move along the metal rails 12a. The rails 12a are conveniently mounted on brackets 14 secured to the inner opposite walls of the tank A as shown in Fig. 2.

The shaft 17 of the sprockets H at the upper left-hand corner of the tank shown in Fig. 1, is provided with spaced-apart cam pulleys 15. Each of the cam pulleys 15 is keyed, as indicated at 16 in Fig. 8, to the shaft 17, and the cam pulleys are located adjacent the sprockets as shown in Fig. 7, so as to be in the paths of travel of the arms 3 which are connected to the flights. Consequently, the pulleys 15 are in positions to be engaged by the arms 3 as the latter are about to successively begin their downward inclined paths of travel.

At the end of the upper run of the conveyer chains the abutments 5 and 8 spread apart as they round the sprockets H, as shown at the upper left-hand portion of Fig. 8. When the abutments 5 and 8 thus spread apart and release the flight, the latter tends to become displaced but the action of the cam pulley 15 is such as to hold the flight 1 by its engagement with the arm 3 in such relation to the lug 5 as to permit the reapproach of the lugs 5 and 8 toward each other to again confine the flight 1 between them, as shown in dotted lines at the lower left-hand portion of Fig. 8, after the arm 3 moves out of contact with the cam pulley 15. It should be understood that when the flight 1 is on top of the sprockets H it is still pushing floating material which has a tendency to rotate the flight in a clockwise direction as viewed in Fig. 8. Consequently when the lugs 8 spread away from the lugs 5 so that the lugs 8 no longer serve as an abutment, the flight 1 will have a tendency on account of the back pressure of the floating material, to turn the flight in a clockwise direction against the abutment face 5a. To counteract this tendency the cam pulleys 15 by acting on the arms 3, serve as abutments to hold the flight in its dotted line position shown in the upper left-hand portion of Fig. 8. When the flight 1 is about to be submerged the lugs 5 and 8 again move toward each other with the flight in proper position to be located between the lugs 5 and 8 as shown in the lower left-hand portion of Fig. 8.

The lower left-hand sprocket shaft 15a carrying the lower left-hand sprockets H as viewed in Figs. 1, 4 and 5, is also provided with cam or guide pulleys 15a adjacent the sprockets H, and keyed as at 16a to the shaft 17a. These pulleys 15a correspond to the pulleys 15 described above, and are also engaged by the arms 3 as the conveyer passes around the lower sprockets H to travel horizontally along the bottom of the tank.

As the conveyer chains pass around the lower sprockets H, the adjacent abutments 5 and 8 spread apart, releasing each flight 1 as the successive flights pass around the sprockets. The arrangement is such that the flights 1 clear the rounded corner 20 of the tank, but come sufficiently close thereto to effect cleaning of any collected matter which may have settled therein. When the abutments 5 and 8 spread apart as shown in dotted lines at the left-hand portion of Fig. 5, the tendency for the flight 1 is to be moved in a clockwise direction particularly when engaging settled matter along the rounded corner 20. However, as the flights are released the arms 3 thereof engage the pulleys 15a to limit the clockwise movement of the flights 1. The arms 3 are guided by the pulleys 15a to cause the flights 1 to follow the curvature of the rounded corner 20. Furthermore, the flights are held adjacent the abutments 5 and 8. Consequently when the abutments 5 and 8 move toward each other again the flight 1 will be held by the arm 3 and the pulley 15a in proper position between them. It will thus be seen that when the flight reaches the bottom 9 of the tank, the abutments 5 and 8 will hold the flight 1 between the same without any aid from the arm 3 and pulley 15a.

It should also be noted that were the guide pulleys 15 and 15a not provided, the buoyancy of the wooden flights in the liquid would prevent proper turning thereof as the conveyer travels downwardly and then horizontally through the tank.

In Fig. 12 the sprockets H are shown provided with flanges 21 which replace the pulleys 15 and 15a described above. The flanges 21 are positioned in the path of travel of the flight arms 3 and guide the arms and flights in the same manner as the pulleys 15 and 15a guide the arms and flights in Figs. 4 and 5.

In order to prevent excessive wear between the wooden flights 1 and the concrete bottom 9 of the tank, such bottom may have inverted metal rails 18, 18 embedded therein, the flights 1 being provided with renewable metal wear plates 19 for engaging the rails 18 as shown in Fig. 2. The upper surfaces of the inverted metal rails 18 are flush with the bottom surface 9 of the tank, and the wear plates 19 have their contacting surfaces flush with the bottom surfaces of the lower flights 1, as viewed in Fig. 2.

By referring to Fig. 6 is will be seen that each flight 1 is closely related to the bracket 5 and the abutment 8 as the flights move horizontally through the tank, either during its upper run or during is lower run. The arm 3 is secured to its pivot shaft 4 by means of suitable cotter pins 24. Fig. 10 shows that the wear plates 19 and 13 are secured to the flight 1 by means of suitable bolts 25 and 26. Figs. 6 and 10 show that the casting 2 is secured to the flight 1 by means of suitable bolts 27.

Figs. 9 and 10 show that the casting 2 has integral therewith the arm 3 and the lug 28. The pivot pin or shaft 4 passes through the lug 28, the brackets 5 and the arm 3 adjacent the base plate of the casting 2. The brackets 5 are arranged in pairs preferably by being made integral with the spaced straps of the link 6, and the straps of the link 6 may be integrally connected together by the pintle bearing as shown at 6 in Fig. 9. In a similar manner the straps of the link 7 may be integrally connected at their trailing ends by a pintle bearing and also integrally connected to the lug 8 extending between the straps of the link 7.

As shown in Fig. 2, the lower end portions of the inner side walls of the tank slope inwardly as indicated at 29, 29. The resulting sloping surfaces 29 serve as guides for facilitating the directing of settled matter into the path of the con-

veyer flights 1, the ends of which fit quite closely between the vertical walls 29', 29'. The arrangement shown in Fig. 2 provides ample space for the mounting of the rail supporting brackets 14, 14 on the uppper portions of the inner walls of the tank A.

The front surfaces of the flights 1 are provided with removable wear plates 30, secured to the flights by the bolts 27 which pass through the casting 2; the flights 1, and the plates 30, being secured in place by means of nuts as shown in Fig. 6. That is to say, the same bolts and nuts which secure the casting 2 to the flights 1 may also be relied on to secure the wear plates 30 to the flights 1 on the sides thereof opposite the casting 2. The dotted lines in Figs. 6 and 10 indicate the area and extent of the wear plates 30 and their positioning for resisting wear by reason of the engagement of the lugs 8 therewith. The wear plates 30 are mounted on the uper portions of the front or leading surfaces of the flights 1 to take the wear incident to engagement of the flights with the brackets 8.

The conveyer E is shown in Fig. 1 arranged in be driven by a suitable motor 31 acting through a standard type of speed reducer 32, power from which is transmitted through gearing 33 to a counter-shaft 34 provided with clutch mechanism 35 as shown in Fig. 7. A sprocket 36 is mounted on the shaft 34 and a sprocket chain 37 connects the sprocket 36 with the drive sprocket 38 on the conveyer drive shaft 39.

A cross conveyer 40 operating in the sump D is adapted to remove collected solids from the sump.

By referring to Fig. 5 it will be seen that if any one of the flights 1 should encounter, in the course of its operation along the bottom 9 of the tank, some obstruction such as that indicated at 22, the chain will buckle as shown in dotted lines at 23, allowing the flight to be released from the abutment 8, whereupon, because of the pivotal mounting of the flight, the latter will drop over onto its face and be carried along on its wear plate 19, as indicated in dotted lines at the right-hand lower portion of Fig. 5. Before the obstruction 22 is encountered the flight 1 is located between the lugs 5 and 8, as shown in full lines in Fig. 5. By the time that the lug 8 travels toward the right a short distance, as shown by the dotted lines immediately to the right of the lug 8 shown in full lines, the link 6 will be tilted upwardly at its rear end on its forward pivot, to the dotted line position 23. The lugs 5 and 8 will thus be spread apart and when the flight 1 is in its inclined dotted line position shown in Fig. 5 it is about to be released from the lug 8. As soon as the flight 1 is released from its abutment 8, the chain snaps back into its normal position, and the flight 1 being carried along on its face, as shown by the dotted lines at the lower right-hand portion of Fig. 5, is already in position to be lifted as shown in Fig. 3, by the stationary cam 82. The arrangement is therefore such as to act as a safety feature in the event that an immovable obstruction is encountered by the flight at the bottom 9 of the tank.

Furthermore, sagging of the chains G in the upper run of the conveyer is preferably avoided, in order that the flights 1 may be properly held in position to perform efficiently the skimming action along the upper surface of the liquid in the tank toward the scum trough 12 shown in the Fig. 1. For this purpose the rails 12a may be positioned beneath the chains G, as indicated in Fig. 11, so that the chains run on the rails 12a and are supported thereby against sagging.

In Figs. 12 to 15, inclusive, cross conveyer mechanism is show in position to act on the floating material after leaving the zone of action of the upper runs of the conveyers in the tanks A and A'. In Figs. 12 to 15, inclusive, the sump 12 of Fig. 1 has been omitted but the depending baffle wall 41 of Fig. 1 has been retained in the form indicated at 41' in Fig. 13. Fig. 12 shows two sedimentation tanks A and A' positioned side by side, each of the tanks being provided with the main conveyer E of Fig. 1. Adjacent the effluent ends of the tanks A and A' are arranged cross conveyer mechanism or auxiliary conveyers indicated generally at J and J', operating in opposite directions so as to convey collected floating material to a common scum trough K. Since the conveyers J and J' are alike in construction, only one need be described in detail.

The auxiliary conveyers may be driven from the main conveyers by connecting sprockets 42 on the shaft 17 with sprockets 43 by means of sprocket chains 44. The sprockets 43 are mounted on shafts 45 journaled in bearings 46, 47, the bearing 46 being illustrated as mounted on the dividing wall 48 between the settling tanks A and A' while the bearings 47 are mounted on brackets 49 carried by the framework 50 supporting the auxiliary conveyers.

The shaft 45 has mounted thereon a bevel gear 51 which meshes with and drives a bevel gear 52 mounted on the end of the shaft 53 carried by the conveyer frame 50. Mounted on the shaft 53 is a conveyer sprocket 54 for driving the endless sprocket chain 59 which is connected to the sprocket 55 on a shaft 56. The shafts 53 and 56 are mounted in bearings 57 and 58 respectively, on the conveyer frame 50.

As shown in Figs 12 and 14 the conveyers J and J' each includes an endless sprocket chain 59 meshing with the sprockets 54 and 55 and carrying the flights 60, preferably of wood, by means of castings 61 secured to chain links at intervals. The flights 60 may be bolted, as indicated at 62 in Fig. 15, to the casting 61. The flights 60 are each provided with a backing plate 63 of steel or other suitable metal, which plate is adapted to ride along the tracks 64 carried by the angles 65 on the plates 66 of the conveyer frame 50. The plates 66 and the angles 67 are bolted to clips 68 anchored in the concrete of the settling tank. Each of the brackets 49 shown in Fig. 12 is reinforced by a plate 69, braced or reinforced by angles 70 and angles 71 as shown in Figs. 14 and 15.

By referring to Fig. 14 it will be seen that the flights 60 are so arranged as to extend downwardly just beneath the liquid level 72 and convey floating material upwardly along the inclined ramp 74 into the scum trough K. The upper edges 75 of the scum trough K occupy positions above the liquid level 72 but the lower ends of the ramps 74 occupy positions beneath the level 72 in each tank or compartment.

As shown in Fig. 14 each ramp may comprise a top plate having a curvature in parallelism with the path of travel of the adjacent sprocket chain, and such curved top plate may be connected by spaced-apart side plates 73. The flights 60 when they emerge from the liquid scrape the accumulated material along the upper surface of the curved top plate 74 and over the edge 75 into the trough or receptacle K. This trough or receptacle K has a bottom closure and enclosing side

walls except that a pipe 62 connects a discharge opening in one of th vertical walls of the receptacle K, to the sump 77 as shown in Fig. 13. As shown in Figs. 12 and 13 the discharge pipe 76 is inclined downwardly through the baffle wall 41', through the adjacent end wall of the tank and across the effluent opening C without interfering with the liquid flowing out from the tank through the effluent C. That is to say, the discharge of the floating materials into the sump 77 and the removal of such material from the sump 77 is entirely separate from the discharge of the liquid through the effluent C.

It should be particularly understood that the influent end of the tank is at B as shown in Fig. 1 and the effluent at C. The lower run of the main conveyer E discharges the sludge or settled solid materials into the sump D and such sludge is removed from the sump D by means of the endless conveyer 40. The upper run of the main conveyer E transfers the floating material or scum toward the effluent end of the tank and toward the baffle wall 41' which extends entirely across the tank or compartment in which it is located. As shown in Fig. 2 the flights F during their upper run occupy positions spanning nearly the entire space between the inner side walls of the tank. Consequently the operation of the upper run of the main conveyer concentrates the floating material in a zone adjacent that side of the baffle wall 41' remote from the effluent C. The liquid minus the settled sludge and the floating material may pass under the lower edge of the baffle wall 41' but the floating material is confined to the zone of operation of the auxiliary conveyer J. The oncoming flights F of the upper run continually push the floating material toward the baffle wall 41' and concentrate or bank such floating material between the side walls of the tank in the zone where the auxiliary conveyer J operates. In order to shorten the space between the zone of operation of the upper run of the main conveyer and the zone of operation of the transverse auxiliary conveyer, the upper left-hand sprockets H, as viewed in Fig. 13, may be adjusted to the positions indicated by the dotted circle H', by adjusting the position of the shaft 17 and removing a few links from the endless sprocket chain 44 so that the latter will have the proper length for transmission of power from the main conveyer to the auxiliary conveyers.

The conveyers J and J' are preferably independently operable each responsive to the operation of the conveyer E to which it is connected, one motor 31 and power transmission mechanism connected thereto being provided for the conveyer mechanism of tank A, and separate power transmission mechanism being provided for the conveyer mechanism of tank A'. For this purpose the shafts 45, 45 of Fig. 12 are separated with their adjacent ends journaled in the bearing 46. If desired, however, the shafts 17 may be connected and a single motor 31 and power transmission mechanism as shown in Fig. 7 relied upon to drive the main conveyers in both tanks A and A' and both auxiliary conveyers J and J'. Such arrangement may be desirable when the dividing wall 48 is partial and not complete in that its top is submerged substantially below the level of the liquid so that the tanks A and A' become virtually a single tank with two communicating compartments.

When wooden flights are used in the main conveyer apparatus, the buoyancy of the flights tends to hold them in a vertical position when they leave the horizontal bottom 9 of the tank and move into the sump D above the inclined wall 80. In order to overcome this tendency and to assure turning of the flights in a clockwise direction, as indicated in full lines at the bottom of Fig. 3, a cam pulley 79 is mounted on the shaft 78 between the sprockets H, H at the lower right-hand corner of the tank. This cam pulley 79 is preferably mounted centrally of the tank or midway between the side walls thereof. The cam pulley 79 is of larger diameter than the diameter of the sprockets H on the shaft 78 so that when the flights I reach the cam pulley 79 the upper edges of the flights will engage the periphery of the cam pulley 79 so that the flight I will be turned clockwise to its full line position shown at the bottom of Fig. 3. As this occurs the abutment 8 spreads away from the abutment 5, thus affording ample space for the flight I for such clockwise movement as viewed in Fig. 3.

Bolted to the inclined wall 80 at 81, 81 is a stationary arcuate guide 82 as shown at the bottom of Fig. 3. At the lower end portion of the arcuate guide 82 is an abutment 83 spaced from the end of the bottom surface 9 to provide ample space for movement of the flight I from its dotted line position at the bottom of Fig. 3 to its full line position and thence toward the arcuate cam surface of the guide 82. The abutment 83 is in position to be engaged by the front or leading face of the flight I so that the latter will be moved to its inclined dotted line position shown at the lower portion of Fig. 3. In other words, the abutment 83 acts to complete the turning movement of the flight in a clockwise direction on the pivot 4. The curved portion of the guide 82 above the abutment 83 is concentric with the shaft 78 and is sufficiently close to the path of travel of the flights to prevent them from turning broadside to the upward path of travel. The upper portion of the guide 82 is parallel to the path of travel of the chain G. It will thus be seen that the action of the guide 82 is such as to hold the flight I substantially parallel to the path of travel of the chain G during movement of the flight upwardly from the abutment 83.

The guide 82 may be positioned substantially midway between the side walls of the tank but it is preferred to locate one of these guides adjacent each side wall or adjacent each of the sprockets H at the lower right-hand portion of the tank, as viewed in Figs. 1 and 3. Likewise one middle cam pulley 79 may be employed but it is preferable to use two pulleys, one adjacent each chain. When steel flights, such as shown in Fig. 16, are employed, the guide 82 is not required, since the weight of the flights is sufficient to cause them to turn in clockwise directions about their pivots 4. In both Figs. 3 and 16 the flights I move edgewise upwardly through the liquid in the tank with the rear sides of the castings 2 resting against the abutment surfaces 5a, and consequently upward movement of the flights through the liquid will create a minimum amount of disturbance of the solid matter held in suspension therein. As hereinbefore fully described, the mechanism shown at the upper right-hand portion of Fig. 3 automatically restores the flights I to their positions between the abutments 5 and 8 for effective transference of the floating material during the upper run of the main conveyer.

The construction and arrangement in connection with the pivoted flights of the main conveyer, including the abutments 5, 8 and the cam pulleys 15, 15a of Figs. 4, 5 and 8, is such that

during the upper run, during the descent through the liquid and during the lower run the flights I are always held in operative positions except when an obstruction at the bottom of the tank is encountered as illustrated in Fig. 5 when the construction embodies a safety feature without interfering with the continuous operation of the main conveyer apparatus. This may readily be seen by comparing Figs. 3 and 5 because if an obstruction 22 effects turning of the wooden flight I to its dotted line position shown at the right-hand portion of Fig. 5, this flight will be automatically moved by reason of its buoyancy to its full line position shown at the lower portion of Fig. 3, when the flight reaches the sump D. Only during movement of the flights upwardly through the liquid are they held parallel to the path of travel of the chains G so that they may move edgewise through the liquid with a minimum amount of disturbance of the matter in suspension therein.

It should also be noted that when the auxiliary conveyors J and J' are operated, their lower runs move toward each other so that a common scum trough or receptacle K may be used. Furthermore, only the lower run of each of the auxiliary conveyors J and J' is active at any time to transfer floating materials because when the flights 60 leave the ramps 74 they are held out of the liquid and are not again dipped thereinto until they reach positions adjacent the walls of the tank remote from the scum trough or receptacle K.

In Fig. 13, the dotted circle H' may represent another position of the sprocket wheels H on the shaft 17, for the purpose of taking up the slack in the chains in a well known manner.

Whether the sprockets H on the shaft 17 are in the positions shown in full lines in Fig. 13 or in the positions represented by the dotted circle H', the flights 60 of the auxiliary conveyer will be in overlapping relation to the flights F when the latter pass under the flights 60. This overlapping relation will be established sooner when the dotted line position H' is employed for the sprockets H on the shaft 17, then when the full line position of Fig. 13 is used. Some of the scum or floating matter that adheres to the flights will be submerged but when directly under the flights 60 such adhering matter will be released by its buoyancy. But even when such overlapping relation does not exist in the apparatus, the upper run of the main conveyer by extending substantially entirely across the upper surface of the liquid in the tank, concentrates, banks and pushes along the floating matter into the zone of operation of the auxiliary conveyer, the active path of travel of which also extends entirely across the upper surface of the liquid immediately adjacent to that side of the baffle wall 41' remote from the effluent C.

The efficiency of the automatic operation of the entire system will become obvious by consideration of the completeness of automatic treatment of the sewage to remove settled sludge and floating material therefrom while the sewage continually flows from the influent slowly through the tank to the effluent. Preliminary sedimentation takes place into the sump D from which the sediment is removed by the conveyer 40. The scum and other floating matter is moved by the upper run of the main conveyer toward the effluent end of the tank A, the flights F projecting upwardly through the liquid surface 72 while the chains G, G remain submerged. During such scum removing run of the main conveyer, the flights F are held by the abutments 5, 8 in right angular relation to the chains. The flights F extend substantially across the entire space between the inner walls of the tank A and therefore the floating matter is banked or crowded up toward the baffle plate 41' which connects the inner walls of the tank A adjacent to the auxiliary conveyer J. Since the flights 60 of the auxiliary conveyer are parallel to the path of movement of the floating matter as effected by the upper run of the main conveyer, such floating matter moves readily between adjacent flights 60 of the lower run of the auxiliary conveyer and near the baffle 41'. Since the auxiliary conveyer J spans the space between such inner walls of the tank A, all the banked or concentrated floating material is positively and rectilinearly moved by the auxiliary conveyer to the scum trough K, thus avoiding entirely any accumulation of stagnant floating material between the main and auxiliary conveyers.

When buoyant flights, such as wooden flights I, are used and the latter reaches the dotted line position shown at the upper left-hand portion of Fig. 8, the abutments 5, 8 spread apart whereupon the flight tends to turn on its pivot in a clockwise direction due to its buoyancy, the counter-balancing of the arms 3 and the pushing action on floating matter still being conveyed. The arms 3 engage the cam pulleys 15 so that the flight will be retained in conveying position while it descends toward the rounded corner 20.

As the flights I sweep along the rounded corner 20 the conveying action on the accumulated sludge tends to effect rotation of the flight on its pivot relatively to the chains, but such rotation is limited by the arms 3 engaging the cam pulley 15a and the flight is held by the abutments 5, 8 at right angles to the chain as the flight scrapes along the bottom of the tank.

If an obstruction 22 is encountered the flight will be released and turned over ninety degrees to its position shown in dotted lines at the right-hand end of Fig. 6, without stalling the operation of the main conveyer. The chain then holds the leading face flat on the bottom of the tank for continuation of a scraping or conveying action along such bottom to the sump D. When above the sloping bottom 80 the buoyancy of the flight tends to move it toward its lower full line position shown in Fig. 3.

But whether the flight is turned over by an obstruction 22 or remains at right angles to the chains, the abutment 83 is engaged by the leading face of the flight to direct it along the cam 82 as shown in Fig. 3.

If the flight remains at right angles to the chains along the bottom of the tank, and is of a buoyant nature, it is desirable to have the cam 79 on the shaft 78 in position to be engaged by the upper edge of the flight as shown in full lines at the bottom of Fig. 3, so as to effect turning of the flight on its pivot to present its leading face to the abutment 83 which when engaged completes the turning of the flight to a position in parallelism to the paths of the chains. When the flight I leaves the upper end of the cam 82, the liquid pressure on the upper edges 10 due to the upward travel through the liquid may be relied on to hold the flights against the abutments 5a, but if such liquid pressure is not sufficient the cam 82 may be extended upwardly to any extent desired.

When metal flights 1ª are used as shown in Fig. 16, the cam pulley 79, the abutment 83 and the cam 82 may be omitted. But whether buoyant flights 1 or metal flights 1ª are used the abutments 11 in the tank are adapted to engage the arms 3 to effect automatic restoration of the flights to scum removing position, as illustrated at the upper right-hand portion of Fig. 3, in readiness for renewal of another automatic cycle of operation of the main conveyer. It should be particularly understood that the cycles of operations of the main and auxiliary conveyers and their co-operation to remove floating matter from the continuously flowing stream of sewage through the tank, are entirely automatic, and that likewise the cycle of operation of the main conveyer in co-operation with the sump conveyer 40, is also entirely automatic to remove sediment from such continuously flowing stream of sewage.

It should also be noted that the flights are each mounted for pivotal movement relatively to the chains on axes 4 which are spaced from the chains and located intermediate the edges of the flights. By extending the brackets 5 laterally from the chains the pivots 4 may be located at the corners between bracket abutment faces which are rectangularly related and include the abutment face 5ª. The spacing of the pivots 4 from the chain also facilitates release of the leading faces of the flights from the abutments 8 and the re-engagement of such leading faces therewith.

In my co-pending divisional application, Serial No. 701,549, filed December 8, 1933, for an Improvement in conveyers, I have described and claimed the auxiliary conveyer mechanism herein disclosed, both separately and in combination with the main conveyer apparatus, whereas in the present application I wish to claim the main conveyer apparatus and its various features both separately and in combination with the tank structure.

In Fig. 2 the inner wall surfaces of the sedimentation tank are shown as being closed and vertical, with the ends of the flights of the upper run spaced from such vertical wall surfaces. The wear plates 13, 13 engage the metal rails 12ª, 12ª which are carried by the brackets 14, 14 mounted on the inner walls. The lower ends of the vertical walls slope inwardly at 29, 29 to the shallow vertical walls 29', 29' closely adjacent which the ends of the flights of the lower run travel. However, if desired, the sloping portions 29, 29 may be omitted by making the lateral inner walls of the sedimentation tank vertical all the way from top to bottom, in which event the ends of the flights of the upper run as well as the ends of the flights of the lower run may be arranged to travel at all times closely adjacent such vertical walls.

In order to increase the effectiveness of the scum removing operation of the upper run of the main conveyer it is preferred to mount the brackets 14 as shown in Fig. 11 so that the spaced-apart chains G, G may travel on the rectilinear rails 12ª, 12ª. In this arrangement sagging of the chain sections between flights will be prevented and since the chains are held by the rails close to the surface of the liquid, all portions of the chain will be able to carry some of the floating material along the surface 72 toward the scum trough 12 shown in Fig. 1 or toward the right-angle auxiliary scum removing conveyer shown in Figs. 12, 13 and 14

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. Conveying apparatus comprising a conveyer chain, a flight pivotally carried by the chain for movement of approximately 90 degrees with respect thereto, and abutment members extending from the chain and engaging the flight for releasably securing the flight in a predetermined position relative to the chain.

2. Conveying apparatus comprising a conveyer chain, of a flight pivotally secured to the chain for pivotal movement through an agle of approximately 90 degrees with respect thereto, and an abutment member extending from the chain and engaging the front face of the flight for securing the flight in a predetermined position relative to the chain.

3. In a conveyer, the combination with a chain formed of pivoted links, spaced abutment means formed on adjacent links, a flight pivotally attached to one of said abutments, said other abutment contacting the front of said flight to retain it in a material conveying position, said chain and abutments being so constructed and arranged as to provide for the pivoting of said flight through approximately 90 degrees upon striking an object.

4. Apparatus for separating sediment from sewage comprising the combination with a sedimentation tank, of a chain conveyer comprising a relatively flat sediment scraping flight, means for guiding said chain conveyer along the bottom of said tank and upwardly through liquid in said tank, and means adapted to present the flat face of said flight toward its direction of travel while moving adjacent the tank bottom and to present its edge toward its direction of travel while moving upwardly in said tank.

5. Apparatus for separating sediment from sewage comprising the combination with a sedimentation tank, of a conveyer adapted to move therein comprising flexible draft means, mechanism for guiding said flexible draft means along the bottom of said tank and substantially vertically upwardly through liquid in said tank, relatively flat sediment scraping flights carried by said flexible draft means, and means at least a portion of which is carried by said flexible draft means adapted to present the flat face of said flight toward its direction of travel while moving adjacent the tank bottom and to present its edge toward its direction of travel while moving upwardly through liquid in said tank.

6. In conveyer apparatus, the combination with a tank, of flexible draft mechanism mounted therein, a flight pivoted to said draft mechanism, means between the draft mechanism and said pivoted flight for holding the latter positively in upright position for positive scraping movement along the bottom surface of the tank, and mechanism in the tank for effecting automatic release of said flight from said holding means and the swinging of the flight on its pivot to an edgewise movement through the liquid immediately after its positive scraping action along the bottom of the tank has been completed.

7. In a conveyer, the combination with draft means, of a material conveying flight of metal

pivotally connected thereto, and abutment mechanism between the trailing side of said flight and said draft means to hold the flight for edgewise movement in an upward path of travel.

8. In a conveyer, the combination with flexible draft means, of a metal flight pivotally connected thereto, guiding mechanism for change of direction of travel of said draft means, and abutment mechanism between the draft means and the leading face of the flight to hold the latter in a conveying position extending transversely of the path of travel of the draft means, said abutment mechanism being adapted to release said flight for pivotal movement relatively to said draft means as the latter articulates about said guiding mechanism, the weight of said metal flight being effective to swing said flight about its pivot when released as aforesaid.

9. In a conveyer, the combination with flexible draft means, of a material moving flight pivotally connected thereto, said flight comprising a channel member having edge flanges extending forwardly in the direction of travel of the draft means during conveying operation of the flight, means for directing the draft means along horizontal and upright paths of travel, and abutment mechanism between the trailing side of said flight and said draft means to hold the flight for edgewise movement when traveling along an upright path.

10. Conveying apparatus comprising the combination with flexible draft means, of a flight pivotally secured thereto, means on the flexible draft means engaging the flight for releasably securing the same in predetermined position relative to the flexible draft means, and means adapted to turn the flight relatively to the flexible draft means incident to change in direction of travel of the flight.

11. In conveying apparatus, the combination with flexible draft mechanism, of a flight pivotally connected thereto for conveying operation thereby, and means comprising an upright cam spaced from said draft mechanism in position to be engaged by the leading face of said flight to guide the latter for travel approximately parallel to and spaced from the path of travel of the draft mechanism when the latter changes direction.

12. In a conveyer, the combination with a flexible chain, of a flight pivotally connected thereto, a sprocket over which said chain travels while changing its direction of travel, abutment mechanism between the chain and the flight for holding the latter with its leading face at right angles to the path of travel of the chain, said abutment mechanism being adapted to release said flight as said chain articulates about said sprocket, and an abutment cam pulley concentric with said sprocket and rotatable therewith in position to be engaged by that edge of the flight adjacent to said chain when the latter changes direction and thereby effect swing of said flight on its pivot away from said right angle position toward an edgewise position.

13. The combination with conveyer apparatus comprising a pivoted flight, of means movable with the flight enabling the latter to pivot automatically substantially 90 degrees from a position transverse of its direction of travel to a position parallel thereto and occupy such parallel position during a predetermined portion of travel of the flight, and means for restoring the flight to its transverse position relative to its direction of travel during another predetermined portion of its travel.

14. Conveying apparatus comprising the combination with flexible draft means comprising a conveyer chain, abutments on adjacent links of the chain, a flight pivoted to the chain for location between said abutments when in operative position, means for guiding said chain along different levels, an arm extending from said flight, and guide means in position to be engaged by said arm to hold the flight between said abutments as the chain moves around said guiding means.

15. In conveyer apparatus, the combination with flexible draft means comprising a chain, of a flight pivotally connected to said chain, means for guiding said flexible draft means comprising a sprocket for receiving said chain, abutments on adjacent links at opposite faces of the flight, an arm extending from the flight, and a pulley concentric with said sprocket and in position to be engaged by said arm to hold the flight between said abutments as the chain moves around the sprocket.

16. In conveyer apparatus, the combination with a conveyer comprising a chain guided around a sprocket and a flight pivoted to the chain, of abutments on the chain at the leading and trailing faces of the flight, of a flange on the sprocket, and an arm extending from the flight in position to engage said flange as the chain moves around the sprocket and thereby effect holding of said flight between said abutments as the chain moves around the sprocket.

17. A scraper conveyer comprising a chain, a flight pivotally connected to a link thereof, an abutment on the next leading link relative to that aforesaid, said abutment having a rear face extending transversely of the path of travel of the chain in position to be engaged by the leading face of the flight at that edge thereof remote from the scraping edge of the flight, means for directing the flight along a curved path downwardly to a surface from which material is to be scraped, and mechanism for maintaining the flight in transverse position relative to the path of said chain and near said abutment as the chain moves along such curved path.

18. The combination of a conveyer flight, and means connecting said conveyer flight to a conveyer chain, the said means comprising a casting including a lug and an arm angularly inclined relative to the flight, the said lug and arm being adapted to receive a pivot pin for pivotally connecting the flight to the conveyor chain, a wear plate positioned on the face of the flight opposite the casting, and common means for securing the casting and the wear plate to said flight.

19. Conveying apparatus comprising the combination with flexible draft means including a chain, of a flight pivoted to one of the links of the chain, and an abutment on the next adjacent link in position to engage the upright leading face of the flight to hold the flight in scraping position relative to the surface along which material is being transferred by the flight.

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