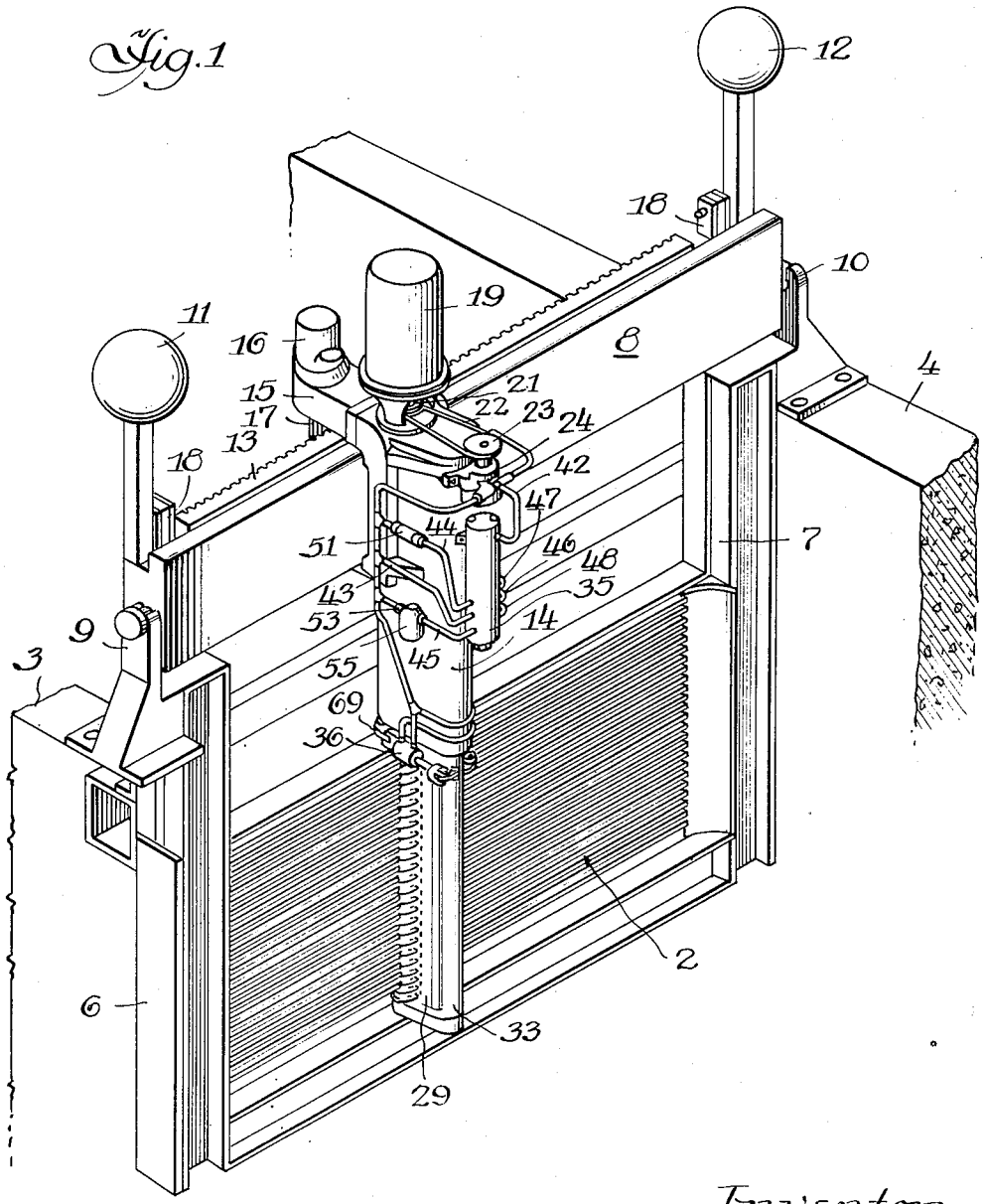
May 10, 1955 A. B. LAUWASSER 2,708,036

COMMINUTING DEVICE

Filed April 28, 1950 4 Sheets-Sheet 1

Fig. 1



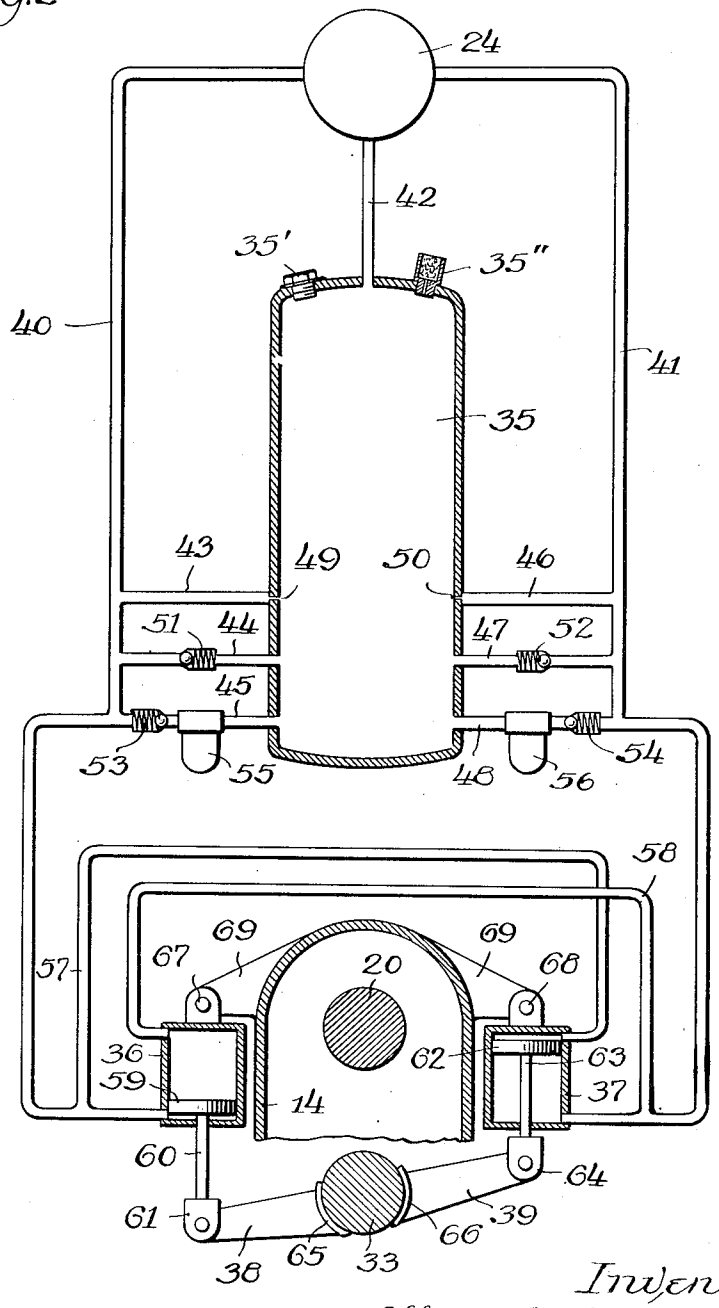

Inventor,
Albert B. Lauwasser,
By: Schneider & Dressler
Attys.

May 10, 1955 A. B. LAUWASSER 2,708,036

COMMINUTING DEVICE

Filed April 28, 1950 4 Sheets-Sheet 2

Fig. 2




Inventor,
Albert B. Lauwasser,
By: Schneider & Dressler,
Attys.

May 10, 1955 A. B. LAUWASSER 2,708,036

COMMINUTING DEVICE

Filed April 28, 1950 4 Sheets-Sheet 3

Fig. 3

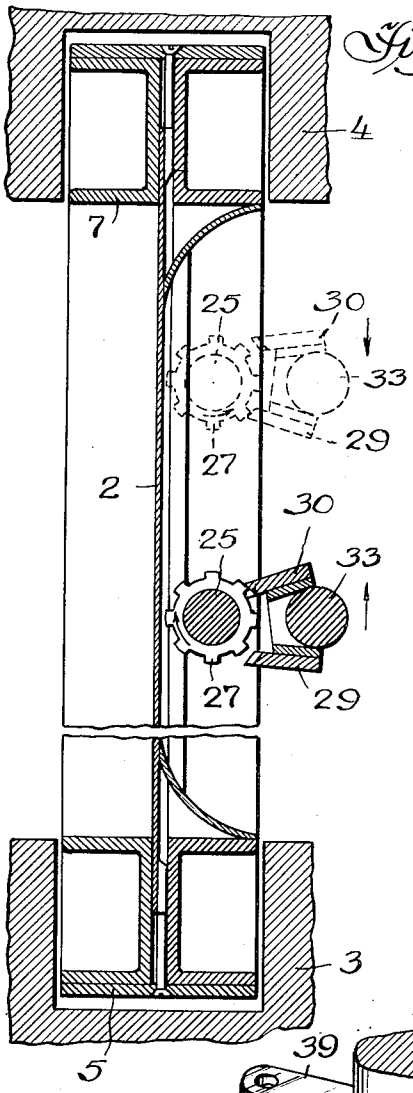



Fig. 4

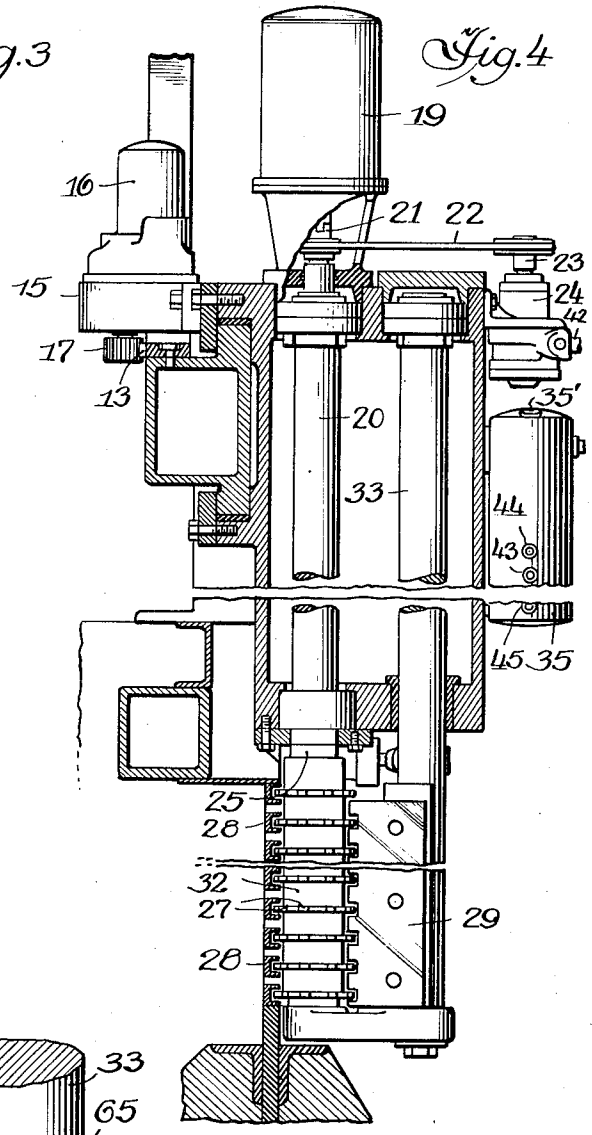
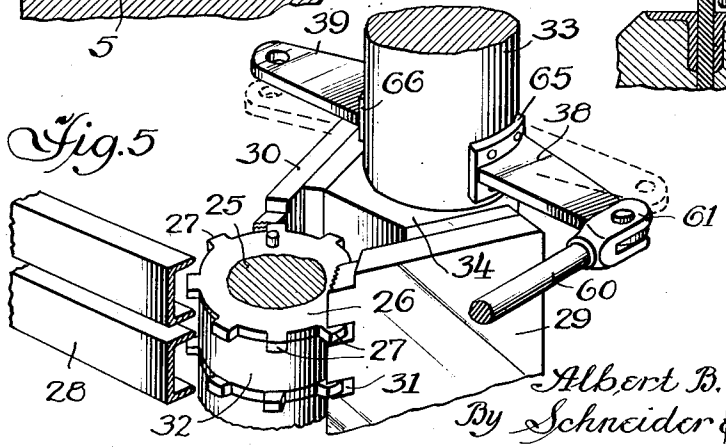



Fig. 5




Inventor,
Albert B. Lauwasser,
By Schneider & Dressler, Attys.

May 10, 1955 A. B. LAUWASSER 2,708,036

COMMINUTING DEVICE

Filed April 28, 1950 4 Sheets-Sheet 4

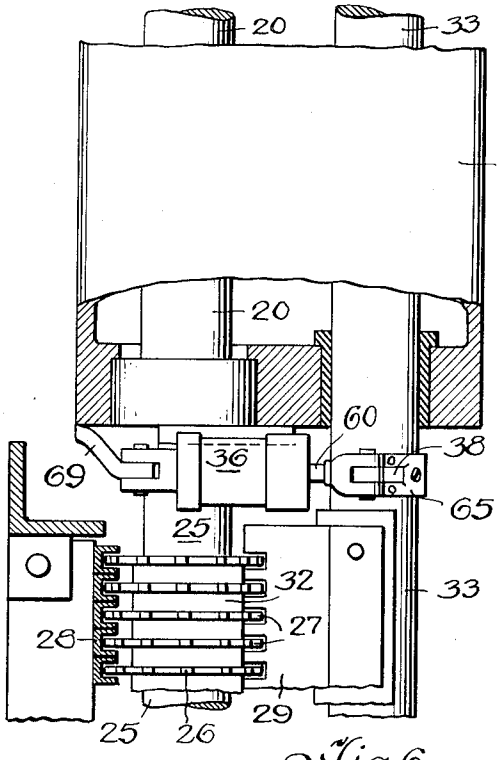



Fig. 6

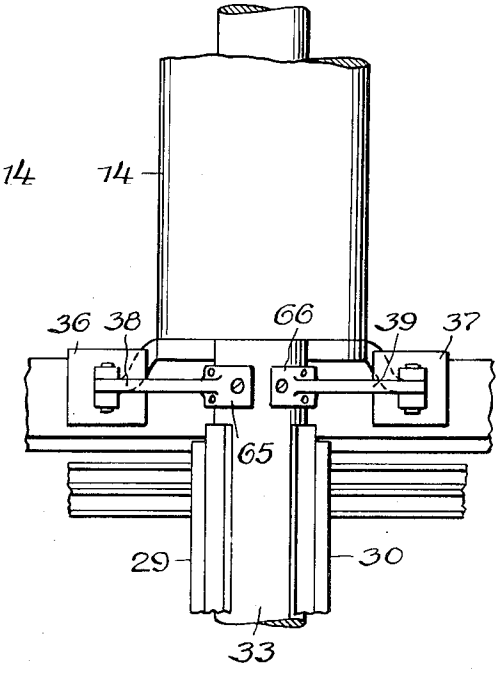



Fig. 7

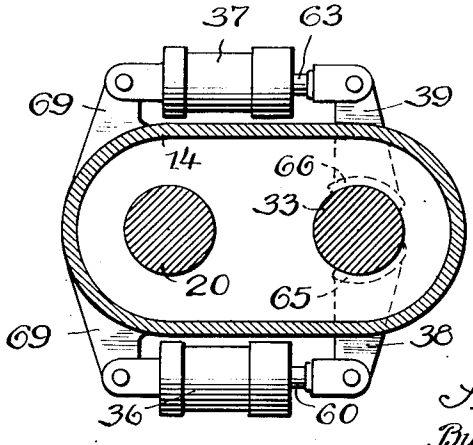



Fig. 8

Inventor,
Albert B. Lauwasser,
By: Schneider & Dressler,
Attys.

United States Patent Office

2,708,036

Patented May 10, 1955



2,708,036

# COMMINUTING DEVICE

Albert B. Lauwasser, Berwyn, Ill., assignor to Chicago Pump Company, a corporation of Delaware

Application April 28, 1950, Serial No. 158,735

10 Claims. (Cl. 210—152)

This invention relates to a comminuting device and particularly to means for oscillating a pair of combs so that the same may alternately cooperate with a cutting cylinder to comminute solids removed by the cutting cylinder from a screen which intercepts the solids in a stream of sewage.

Although the invention will be described specifically in connection with a comminuting device as disclosed in the application of Carl H. Nordell filed September 24, 1948, under Serial No. 50,925, now abandoned, it will be understood that the present device is not limited to use with the specific type of comminuting device disclosed in said application, but may be used advantageously with any suitable type of comminuting device.

In the Nordell application the comminuting device includes a rotating shaft provided with a cutting cylinder having laterally projecting teeth which are adapted to remove the solids from the face of the screen, and another shaft adapted to carry a pair of combs either of which may be alternately moved into the path of rotation of the teeth, depending upon the direction of travel of the comminuting device. The comb in operative position cooperates with the teeth on the rotating cutting cylinder to comminute the solids to a size so that they can be carried through the screen by the flow of the liquid sewage. In this comminuting device comminution of the intercepted solids is effected upstream in the sewage stream and off of the face of the screen.

The present invention is concerned primarily with means for alternately positioning the combs so that each time the direction of rotation and lateral travel of the cutting cylinder is reversed, the proper comb is positioned to cooperate with the cutting cylinder to comminute the solids.

In the preferred embodiment of the invention hydraulic means for positioning the combs are operated automatically by reversal of the motor which rotates the cutting cylinder. This motor is reversed automatically each time the cutting cylinder reaches the end of its linear travel.

The most important characteristic of the present invention is the dependability of the system by which the position of the combs is positioned at the end of each stroke. If too great a mass of solids accumulates on the comb in operative position, the hydraulic system permits the comb to yield slightly under the impact of the teeth of the cutting cylinder against the mass of solid matter so that the teeth will not be broken. As soon as the mass of solid matter has been reduced, either by comminution or by being knocked off the comb by the cutting cylinder, the hydraulic pressure again forces the comb back into its operative position. The mechanism of the present invention is simple and inexpensive to manufacture and to maintain, and efficient in operation.

The structure by which the above noted and other advantages of the present invention are attained will be



described in the following specification, taken in conjunction with the accompanying drawings showing a preferred illustrative embodiment of the invention, in which:

Figure 1 is a perspective view of the screen and comminuting device embodying the hydraulic comb oscillating means of the invention;

Fig. 2 is a diagrammatic view, showing the hydraulic system by means of which the combs are properly positioned with respect to the rotating cutting teeth;

Fig. 3 is a horizontal cross sectional view showing, in solid and dotted lines, the relative positioning of the combs and the screen as the comminuting element travels in opposite directions;

Fig. 4 is an enlarged, fragmentary, vertical cross sectional view of the comminuting device;

Fig. 5 is an enlarged detail perspective view showing the cutting cylinder, the combs, and a portion of the shaft operable to position the combs;

Fig. 6 is an enlarged fragmentary side elevation showing the screen, cutting cylinder and one of the combs in operative relationship;

Fig. 7 is an enlarged fragmentary rear elevation of the structure shown in Fig. 6; and

Fig. 8 is an enlarged cross sectional view, showing the means for oscillating the shaft which positions the combs relative to the cutting cylinder.

In the drawings, the reference numeral 2 indicates a screen positioned transversely between a pair of concrete walls 3 and 4 which define the channel through which sewage flows. The screen is supported by a frame comprising a base member 5, and side members 6 and 7. A cross bar 8 is pivotally mounted in trunnions 9 and 10 which extend vertically above side members 6 and 7. Counterweights 11 and 12 facilitate the pivotal movement of cross bar 8.

A rack 13 is secured to cross bar 8 adjacent the top edge thereof. A comminuting device includes a housing 14 which has an arm 15 extending rearwardly therefrom. Arm 15 supports a reversible motor 16 which operates a pinion gear 17 in engagement with rack 13. Motor 16 is controlled by a trip switch 18 at each end of cross bar 8 which reverses the motor automatically so that housing 14, and its associated structure, is continuously reciprocated along cross bar 8.

A motor 19 mounted on the top of housing 14 is connected to a vertical shaft 20 through a coupling 21. Motor 19 is connected to the same electrical circuit as motor 16 and is controlled by the same switches 18 or separate switches, as desired, so that it is reversed simultaneously with motor 16. Shaft 20 is rotated by motor 19 and in turn rotates a belt 22 which drives the shaft 23 of a pump 24.

A vertical shaft 25, aligned with shaft 20, is rigidly connected thereto and rotates therewith. The cutting cylinder comprises a plurality of annular disks 26 rigidly mounted on shaft 25. Each disk 26 is provided with a plurality of laterally projecting cutting teeth 27 which cooperate with channel shaped screen bars 28 to remove intercepted solids held against the screen by the force of the sewage flowing through the screen. The solids removed from the screen teeth 27 are carried by the teeth around to one of a pair of combs 29 or 30, depending upon the direction of rotation of shaft 25, and are comminuted by the interaction of teeth 27 and the walls defining the recesses 31 in the forward edges of the combs. The annular disks are spaced vertically by collars 32 to align them with the screen bars 28 and the recesses 31. This comminuting structure is described more fully in the above-mentioned Nordell application.

A shaft 33, extending parallel to shafts 20 and 25 is pivotally mounted in housing 14. The length of shaft

33 is substantially equal to the combined length of shafts 20 and 25. A frame 34 (Fig. 5) is rigidly secured to the lower portion of shaft 33, and combs 29 and 30 are rigidly mounted on frame 34 in converging relationship. The converging ends of combs 29 and 30 are spaced apart a sufficient distance so that when recesses 31 of one comb engage teeth 27 the forward edge of the other comb is spaced from the teeth, as shown in Figs. 3 and 5.

The rotation and direction of rotation of teeth 27 is controlled by motor 19 every time the comminuting device reaches either lateral edge of the screen, as by trip switches 18 or other suitable switching means, as pointed out above. For effective comminuting action, comb 30 is in proper position when shaft 25 is rotated clockwise as it moves laterally towards the right, as viewed in Fig. 3. The proper positioning of the parts when the direction of rotation and of travel of shaft 25 are reversed is shown in dotted lines in Fig. 3.

The position of combs 29 and 30 is controlled by a hydraulic system which comprises pump 24, a reservoir 35, a pair of double acting hydraulic cylinders 36 and 37 and arms 38 and 39. As previously mentioned, pump 24 is driven by belt 22 mounted on shaft 20. The direct connection between pump 24 and shaft 20 through belt 22 causes the direction of rotation of shaft 23 of the pump to alternate with the changes in direction of the rotation of shaft 20. As previously mentioned, motor 19 is automatically reversed every time motor 16 is reversed by trip switches 18, so the direction of rotation of shafts 20 and 23 is changed every time the direction of lateral travel of the comminuting device is changed.

Each port of pump 24 is connected to the reservoir through a feeder line 40 or 41. Another line 42, leading from the pump to the reservoir serves as a drain line for the oil seal chamber within the pump. The reservoir has a screw threaded plug 35' closing its filling opening and an air vent 35''. Feeder line 40 leads to cylinder 36, and feeder line 41 leads to cylinder 37. Three branch lines 43, 44 and 45 lead from feeder line 40 to the lower end of reservoir 35. Three similar lines 46, 47 and 48 lead from feeder line 41 to the lower end of reservoir 35. Lines 43 and 46 have restricted orifices 49 and 50, respectively. These orifices maintain the pressure in the system. Lines 44 and 47 contain pressure relief valves 51 and 52, respectively, which permit flow from the pump to the reservoir only, under conditions of extreme overload. Lines 45 and 48 contain check valves 53 and 54 and oil filters 55 and 56, respectively. These lines permit flow from the reservoir to the pump. Cylinders 36 and 37 are interconnected by lines 57 and 58 so that oil introduced into the front side of one cylinder is also introduced to the back side of the other cylinder.

The relative positions of lines 43 and 46 with respect to lines 44 and 47 and 45 and 48 are different in Fig. 2 from what they are in Fig. 1. This difference is of no moment insofar as the operation is concerned. The difference was made in the diagrammatic view (Fig. 2) to facilitate illustration.

Cylinder 36 has a piston 59 fitting therein. A piston rod 60 extends from the rear side of piston 59 through the back wall of cylinder 36 and is provided with a clevis 61 at its other end. Cylinder 37 is similarly provided with a piston 62, piston rod 63 and clevis 64. One end of arm 38 is pivotally secured in clevis 61 and the other end is rigidly secured to a plate 65 mounted on shaft 33 for movement therewith. One end of arm 39 is similarly secured in clevis 64 and its other end is rigidly secured to a plate 66 mounted on shaft 33 for movement therewith, on the opposite side from plate 65. Cylinders 36 and 37 are each secured in place on opposite sides of housing 14 by means of connections 67 and 68 and a plate 69 rigidly mounted on the housing.

To illustrate a typical operation of the system, Fig. 2 shows the pistons 59 and 62 in the positions they occupy when comb 30 is in operative position to engage teeth 27



of the cutting cylinder to comminute solids removed from screen 2 by the teeth and carried by the teeth around to comb 30. Assume that the comminuting device has reached the end of the screen towards which it has been moving and motor 16 has just been reversed by trip switch 18. Reversal of motor 19 simultaneously with reversal of motor 16 also reverses the action of pump 24, causing the oil to flow through line 40 into cylinder 36 on the rear side of piston 59 and through line 57 into cylinder 37 on the front side of piston 62. The force of the oil moves piston 59 upwardly and piston 62 downwardly, as viewed in Fig. 2, thereby reversing arms 38 and 39 and oscillating shaft 33 a predetermined distance to move comb 30 out of the path of travel of teeth 27 and moving comb 29 into said path of travel so that teeth 27 pass through recesses 31 in comb 29.

The movement of shaft 33 takes very little time and when it is completed the pump continues to pump oil, taking it from reservoir 35 through line 48, oil filter 56 and check valve 54 and back into the reservoir through line 43. Since piston 59 is then at the upper end of cylinder 36 and piston 62 is at the lower end of cylinder 37, the oil cannot flow through lines 40 and 57. The pressure ordinarily is not sufficient to force the oil through pressure relief valve 51 and therefore the only place it can flow is through line 43 back into the reservoir. Orifice 49 is small enough to restrict the flow therethrough so as to build up the pressure sufficiently to hold pistons 59 and 62 in their extreme positions and thereby hold the comb 29 in operative position. Relief valve 51 prevents pressure overloads by permitting the flow of oil therethrough into the reservoir when the oil pressure increases beyond the pressure necessary to maintain the pistons in their extreme positions.

When the comminuting device traverses the screen 2 and the motors 16 and 19 are reversed, the process described above is repeated with the oil flowing through lines 41 and 58. The pump continues to pump and oil is now pumped through line 45, filter 55 and check valve 53 and back into the reservoir through line 46.

The reversal of the comminuting device at each end of the screen places a considerable load on the teeth and comb moved into operative position because of the accumulation of solids which gradually has been built up against the comb previously in operative position during the movement of the comminuting device in the opposite direction. For this reason it is desirable that the comb be moved into operative position gradually so that the accumulation of solids can be thrown clear of the comb upon reversal of the comminuting element. The hydraulic system described fulfills these requirements adequately because of the interval of time it takes to remove the oil from one side of each piston and to feed it into the cylinder on the opposite side of the piston. The hydraulic system also has a certain amount of flexibility which permits the combs to move slightly out of position against the pressure of the oil when there is a sudden overload of solids against the comb.

Although I have described a preferred embodiment of my invention in considerable detail, it will be understood that the description is intended to be illustrative, rather than restrictive, as many details may be modified or changed, without departing from the spirit or scope of the invention. Accordingly, I do not desire to be restricted to the exact structure disclosed.

I claim:

1. In a comminuting device, a bar, a pair of parallel shafts, supporting means for said shafts movably mounted on said bar, a motor for moving said supporting means and shafts along said bar, a reversing switch adjacent each end of said bar, said reversing switches being engageable with said supporting means to reverse said motor at each end of the path of travel of said supporting means, means for rotating one of said shafts, a cutting cylinder rigidly mounted on said rotating shaft, a

plurality of teeth projecting laterally from said cutting cylinder, a hydraulic system including a pump, a pair of double acting cylinders, a piston reciprocably mounted in each of said cylinders, a piston rod extending from each of said pistons through one wall of the cylinder in which said piston is mounted, and a pair of arms rigidly secured in circumferentially spaced relationship to said other shaft, the other end of each of said arms being connected to one of said piston rods, said pump being driven by said shaft rotating means to reciprocate said pistons and thereby oscillate said other shaft through a predetermined arc, and a pair of combs rigidly mounted on said last mentioned shaft in position to alternately cooperate with said teeth to comminute solids engaged between said teeth and one of said combs at each extreme position of said combs.

2. A comminuting device comprising a laterally movable cutting cylinder mounted on a vertical shaft, a reversible motor operable to move said shaft laterally, a pair of switches adjacent opposite ends of the lateral path of travel of said shaft, said switches being operable automatically to reverse said motor when said shaft reaches either end of its lateral path of travel, a pair of combs mounted on a shaft parallel to said first mentioned shaft, means to rotate said first mentioned shaft in one direction while it is moving laterally in one direction, means to reverse the rotation of said first mentioned shaft to rotate it in the opposite direction while it is moving laterally in the opposite direction, and hydraulic means operated by said rotating means for oscillating said combs to position one of said combs into position to engage said cutting cylinder when it is rotating in one direction and to position said other comb into position to engage said cutting cylinder when it is rotating in the opposite direction, said hydraulic means comprising a pump, a pair of pistons reciprocated by said pump, a piston rod extending from each of said pistons, and a pair of arms, said arms being each connected at one end to one of said piston rods and at its other end to said second mentioned shaft in circumferentially spaced relationship.

3. A comminuting device comprising a laterally movable cutting cylinder mounted on a vertical shaft, a reversible motor operable to move said shaft laterally, a pair of switches adjacent opposite ends of the lateral path of travel of said shaft, said switches being operable automatically to reverse said motor when said shaft reaches either end of its lateral path of travel, a pair of combs mounted on a shaft parallel to said first mentioned shaft, means to rotate said first mentioned shaft in one direction while it is moving laterally in one direction, means to reverse the rotation of said first mentioned shaft to rotate it in the opposite direction while it is moving laterally in the opposite direction, and a hydraulic pumps operated by said rotating means, a pair of pistons reciprocated by said pump, and an arm operatively connected to each of said pistons, each of said arms being secured at its other end to said second mentioned shaft in circumferentially spaced relationship for oscillating said combs to position one of said combs into position to engage said cutting cylinder when it is rotating in one direction and to position said other comb into position to engage said cutting cylinder when it is rotating in the opposite direction, said hydraulic pump maintaining said one comb in position to engage said cutting cylinder until the direction of rotation of said cutting cylinder is reversed.

4. In a comminuting device, a bar, a pair of parallel shafts, supporting means for said shafts movably mounted on said bar, a motor for moving said supporting means and shafts along said bar, a reversing switch adjacent each end of said bar, said reversing switches being engageable with said supporting means to reverse said motor at each end of the path of travel of said supporting means, means for rotating one of said shafts, a cutting cylinder rigidly mounted on said rotating shaft, a plu-



rality of teeth projecting laterally from said cutting cylinder, a hydraulic pump driven by said shaft rotating means, a pair of pistons reciprocated by said pump, and a pair of arms extending laterally from said other shaft, each of said arms being operatively connected to one of said pistons to oscillate said other shaft through a predetermined arc, and a pair of combs rigidly mounted on said last mentioned shaft in position to alternately cooperate with said teeth to comminute solids engaged between said teeth and one of said combs at each extreme position of said combs at each end of said oscillatory movement of said last mentioned shaft, said pump maintaining said combs in their extreme position after every oscillation of said last mentioned shaft but permitting slight backward movement of said combs under pressure from excessive amount of solid material engaged between said teeth and either of said combs.

5. In a comminuting device, a bar, a pair of parallel shafts, a reversible motor for moving said shafts relative to said bar, reversible means for rotating one of said shafts, a cutting cylinder rigidly mounted on said rotating shaft, a plurality of teeth projecting laterally from said cutting cylinder, a hydraulic pump driven by said shaft rotating means, a pair of pistons operatively connected to said pump, and a pair of arms extending laterally from said other shaft, each of said arms being operatively connected to one of said pistons, said pump cooperating with said pistons and arms to oscillate said other shaft through a predetermined arc, a pair of combs rigidly mounted on said last mentioned shaft in position to alternately cooperate with said teeth to comminute solids engaged between said teeth and one of said combs at each extreme position of said combs at each end of said oscillatory movement of said last mentioned shaft, and means for automatically reversing said pump upon reversal of said shaft rotating means to reverse the position of said combs.

6. In a comminuting device, a bar, a pair of parallel shafts, supporting means for said shafts movably mounted on said bar, a motor for moving said supporting means and shafts along said bar, a reversing switch adjacent each end of said bar, said reversing switches being engageable with said supporting means to reverse said motor at each end of the path of travel of said supporting means, a reversible motor for rotating one of said shafts, a cutting cylinder rigidly mounted on said rotating shaft, a plurality of teeth projecting laterally from said cutting cylinder, hydraulic means oscillating said other shaft through a predetermined arc, said means comprising a pump, an oil reservoir, a pair of double acting cylinders, a plurality of pipe lines interconnecting said pump, reservoir and cylinders, pistons reciprocably mounted in each of said cylinders, a piston rod extending from each of said pistons through one wall of the cylinder in which said piston is mounted, and a pair of arms, each of said arms being secured at one end to said other shaft and at the opposite end to one of said piston rods, and a pair of combs rigidly mounted on said last mentioned shaft in position to alternately cooperate with said teeth to comminute solids engaged between said teeth and one of said combs at each extreme position of said combs at each end of said oscillatory movement of said last mentioned shaft, said pump exerting constant pressure against one of said pistons to maintain said combs in their extreme position after every oscillation of said last mentioned shaft, and relief valves in said pipe lines whereby a portion of the oil in either cylinder is removed therefrom automatically to reduce pressure temporarily against either of said combs caused by excessive amounts of solid material engaged between said teeth and either of said combs, such pressure reduction in either cylinder causing the comb positioned by the piston in said cylinder to be forced backwardly to a slight extent by the pressure exerted by such excessive amount of solid material, means

for reversing said pump automatically upon reversal of said motor to reverse the position of said combs.

7. In combination with a screen for straining sewage, a comminuting device comprising a cutting cylinder, a reversible motor reciprocating said cutting cylinder across said screen, a pair of switches adjacent opposite edges of said screen, said switches being operable automatically when said cutting cylinder reaches either end of said screen to reverse said motor, another reversible motor rotating said cutting cylinder in one direction when its lateral movement is in one direction, means to reverse said second mentioned motor to rotate said cutting cylinder in the opposite direction when its lateral direction is reversed, said cutting cylinder removing solids from said screen, a pair of combs mounted on a shaft spaced from said cutting cylinder, and a hydraulic pump operated by said second mentioned motor, a pair of pistons operatively connected to said pump, and a pair of arms operatively connected to said pistons, each of said arms being rigidly secured at its other end to said shaft, said pump, pistons and arms cooperating to oscillate said shaft to position one of said combs into position to engage said cutting cylinder, and to hold it in said position until the rotation of said cutting cylinder is reversed, to comminute solids removed from said screen by said cutting cylinder and engaged between said cutting cylinder and said comb.

8. In combination with a screen for straining sewage, a comminuting device comprising a cutting cylinder, a reversible motor reciprocating said cutting cylinder across said screen, a pair of switches adjacent opposite edges of said screen, said switches being operable automatically when said cutting cylinder reaches either end of said screen to reverse said motor, another reversible motor rotating said cutting cylinder in one direction when its lateral movement is in one direction, means to reverse said second mentioned motor to rotate said cutting cylinder in the opposite direction when its lateral direction is reversed, said cutting cylinder removing solids from said screen, a pair of combs mounted on a shaft spaced from said cutting cylinder, a hydraulic pump operated by said second mentioned motor, a pair of double acting cylinders, a plurality of pipe lines interconnecting said cylinders and said pump, a pair of arms extending laterally from said shaft, a piston in each of said cylinders, said pistons being each operatively connected to one of said arms to oscillate said shaft to position one of said combs into position to engage said cutting cylinder, and to hold it in said position until the rotation of said cutting cylinder is reversed, to comminute solids removed from said screen by said cutting cylinder and engaged between said cutting cylinder and said comb, and a pair of relief valves in said pipe lines, said valves reducing the holding force of said pistons when solids engaged between said cutting cylinder and said comb form too great a mass to permit proper comminution, thereby causing the pressure of said solids against said comb to temporarily move said comb backwards against the force of the piston tending to hold said comb in engagement with said cutting cylinder.

9. In combination with a screen for straining sewage, a comminuting device comprising a cutting cylinder, a reversible motor reciprocating said cutting cylinder across said screen, a pair of switches adjacent opposite edges of said screen, said switches being operable automatically when said cutting cylinder reaches either end of said screen to reverse said motor, another reversible motor rotating said cutting cylinder in one direction when its lateral movement is in one direction, means to reverse said second mentioned motor to rotate said cutting cylinder in the opposite direction when its lateral direction is reversed, said cutting cylinder removing solids from said screen, a pair of combs mounted on a shaft spaced from said cutting cylinder, a pair of arms extending laterally from said shaft, and a hydraulic pump operated by said second mentioned motor cooperating with a pair of pistons operatively connected to said arms and said pump to oscillate said shaft to position one of said combs into position to engage said cutting cylinder when said cutting cylinder is rotating in one direction, and to position said other comb into position to engage said cutting cylinder when said cutting cylinder is rotating in the opposite direction.



10. In combination with a screen for straining sewage, a comminuting device comprising a cutting cylinder, a reversible motor reciprocating said cutting cylinder across said screen, a pair of switches adjacent opposite edges of said screen, said switches being operable automatically when said cutting cylinder reaches either end of said screen to reverse said motor, another reversible motor rotating said cutting cylinder in one direction, means to reverse said second mentioned motor to rotate said cutting cylinder in the opposite direction when its lateral direction is reversed, said cutting cylinder removing solids from said screen, a pair of combs mounted on a shaft spaced from said cutting cylinder, a pair of arms rigidly secured to said shaft and extending laterally therefrom, a hydraulic pump operated by said second mentioned motor, a pair of double acting cylinders, a plurality of pipe lines interconnecting said pump and said cylinders, a piston in each of said cylinders, said pistons each being operatively connected to one of said arms, said pump reciprocating said pistons to oscillate said shaft to position one of said combs into position to engage said cutting cylinder when said cutting cylinder is rotating in one direction, and to position said other comb into position to engage said cutting cylinder when said cutting cylinder is rotating in the opposite direction, said pistons holding each of said combs in its operative position until the rotation of said cutting cylinder is reversed, and a pair of relief valves in said pipe lines, said valves reducing the holding force of said pistons when solids engaged between said cutting cylinder and said comb form too great a mass to permit proper comminution, and thereby cause the pressure of said solids against the comb in operative position to temporarily move said comb backwards against the force of the piston tending to hold said comb in operative engagement with said cutting cylinder.


**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,982,266 | Nordell | Nov. 27, 1934 |
| 2,282,194 | Lamond | May 5, 1942 |
| 2,305,935 | Thom | Dec. 22, 1942 |
| 2,358,655 | Nordell | Sept. 19, 1944 |
| 2,484,079 | Davis | Oct. 11, 1949 |
| 2,517,528 | Moore | Aug. 1, 1950 |
| 2,672,985 | Nordell | Mar. 23, 1954 |