

June 2, 1959

O. L. NORDIN

2,889,048

STRAINERS

Filed Feb. 8, 1954

5 Sheets-Sheet 1

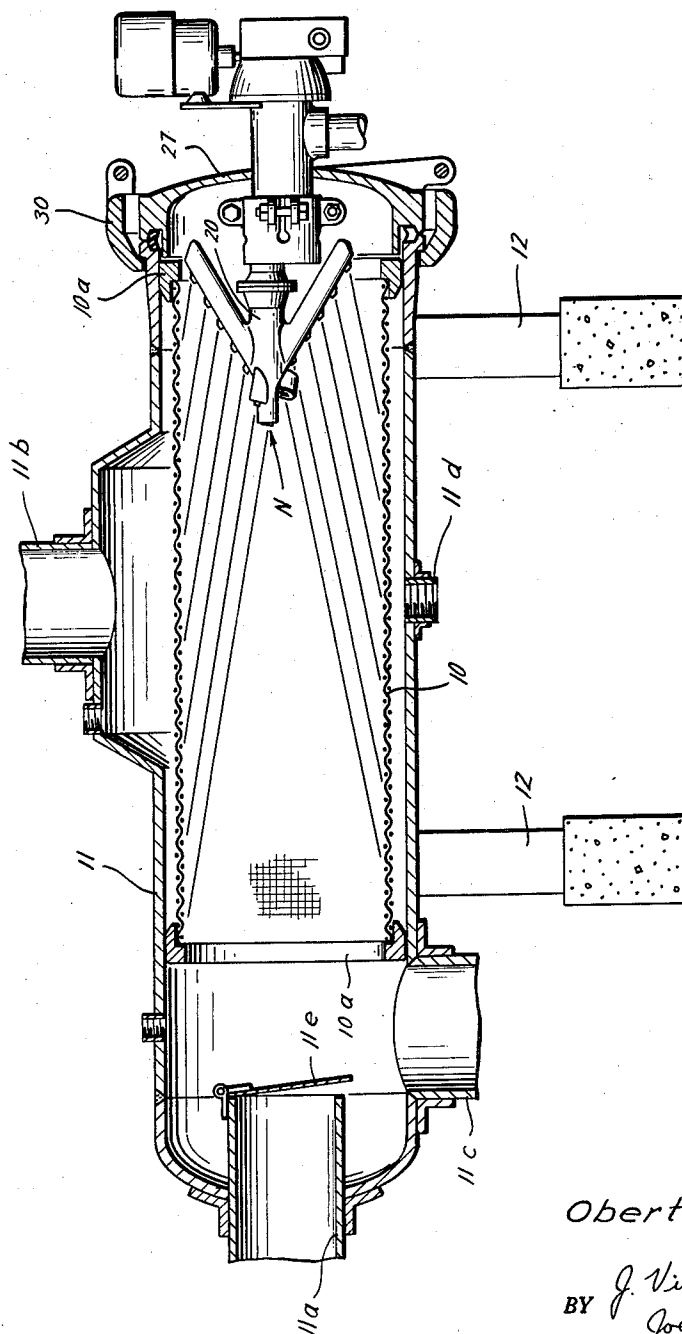


Fig. 1

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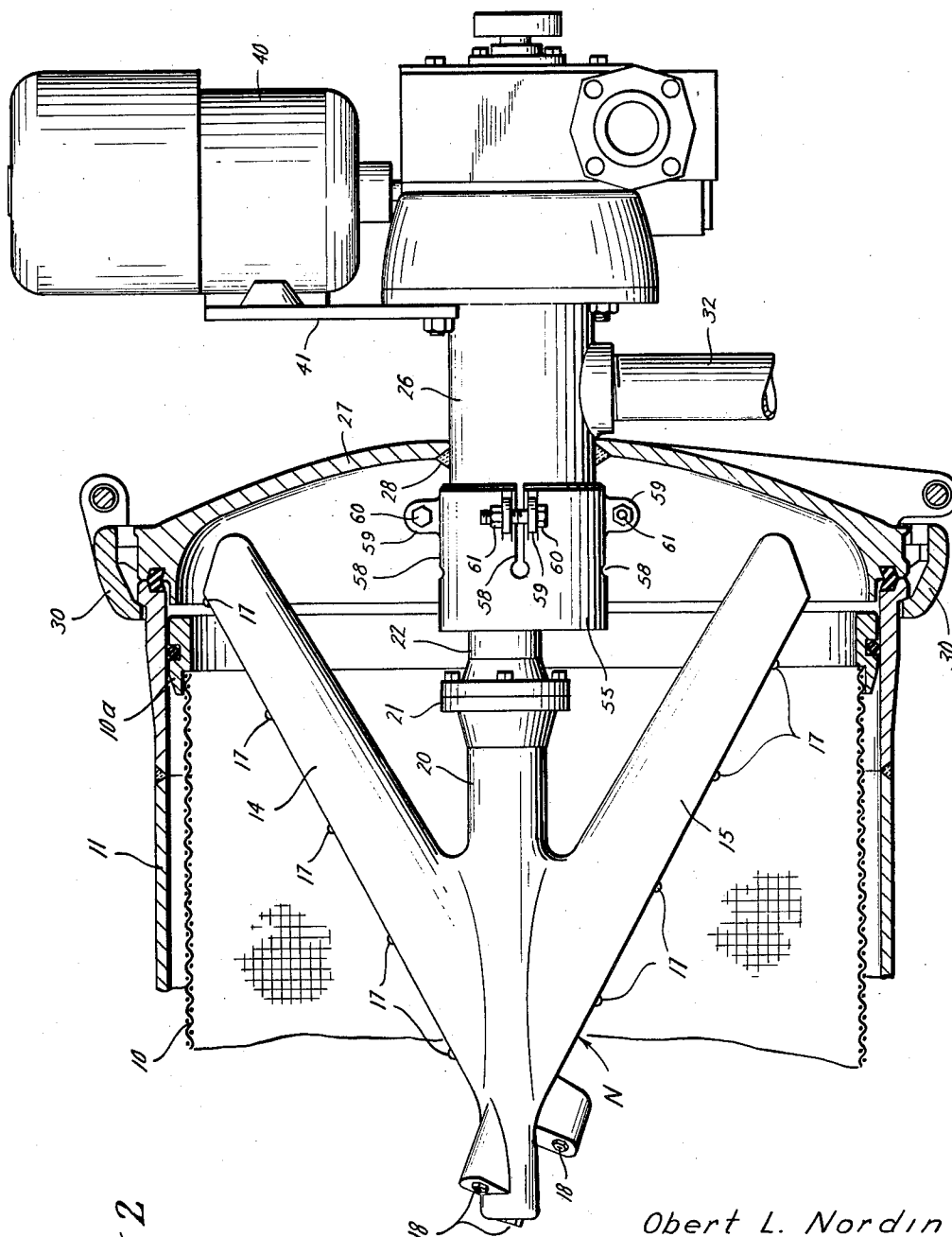
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5 Sheets-Sheet 2



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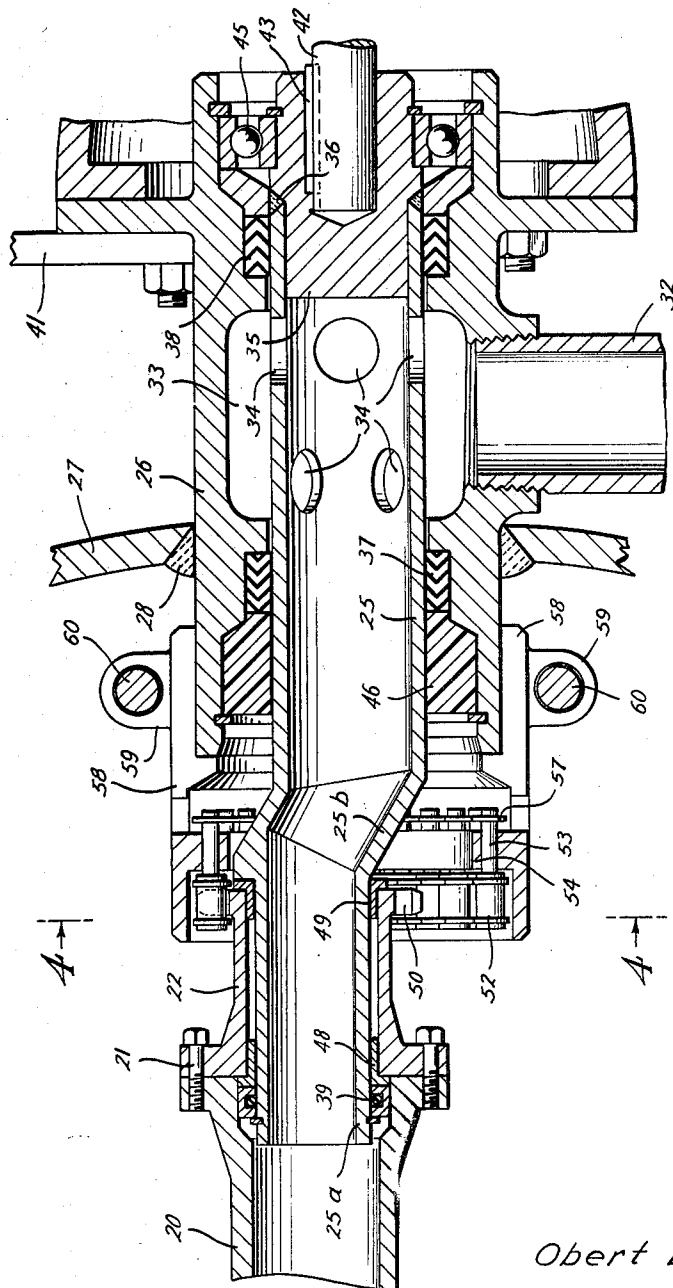
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5 Sheets-Sheet 3



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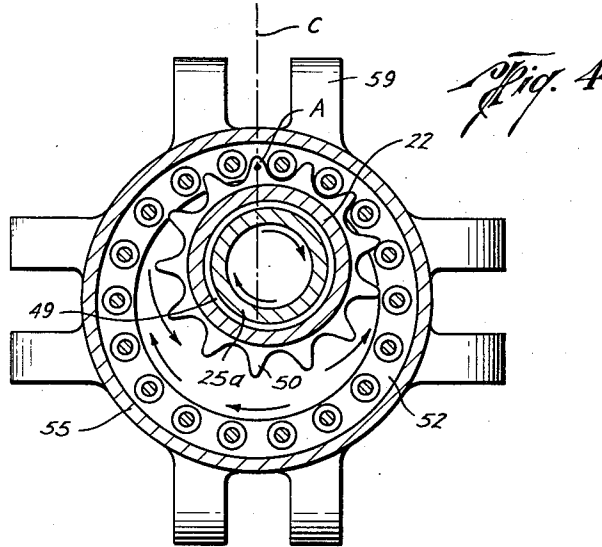
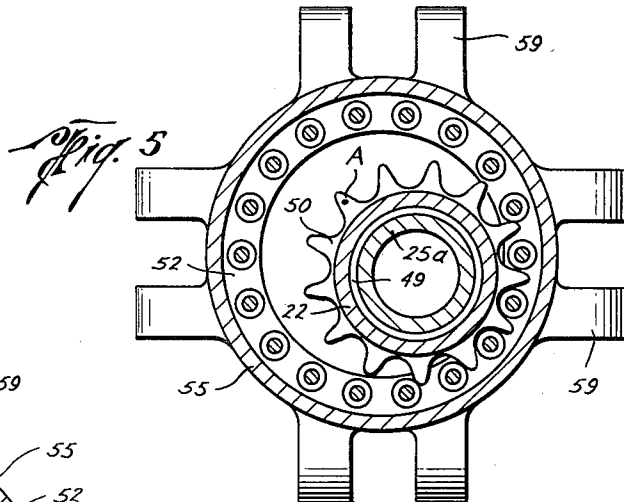
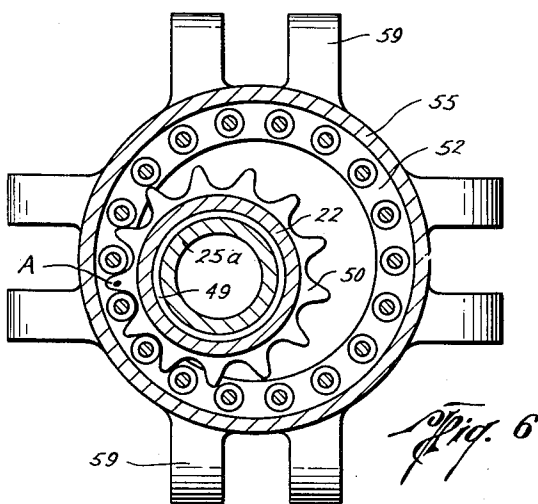
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5 Sheets-Sheet 4



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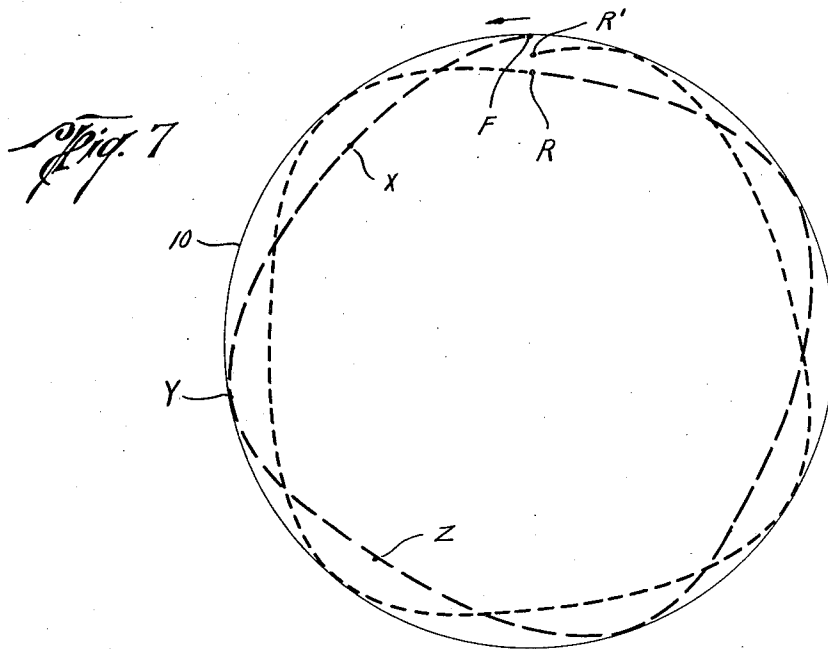
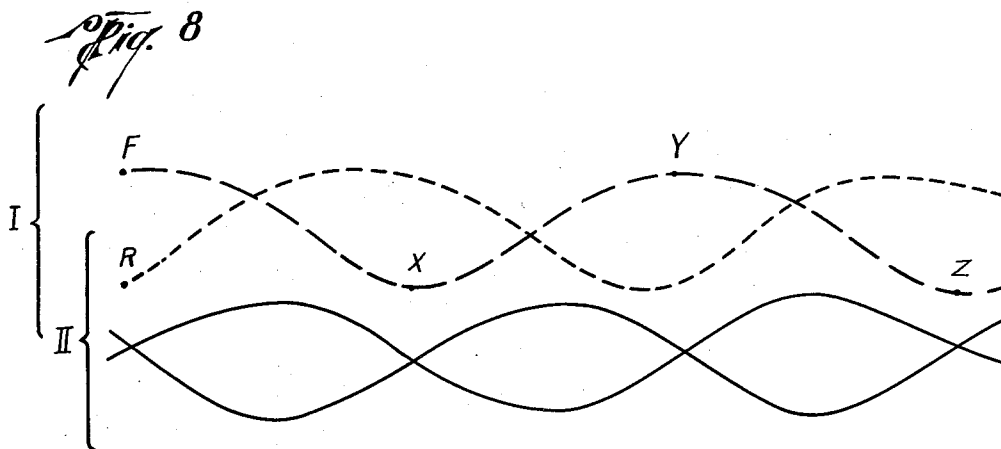
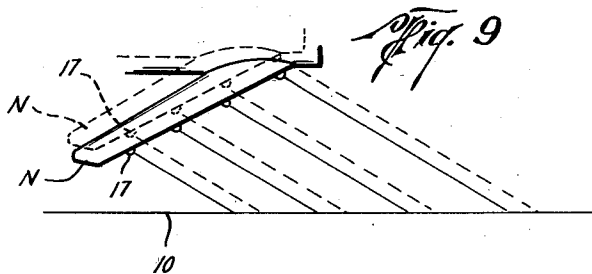
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STRAINERS

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5 Sheets-Sheet 5



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STRAINERS

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19 Claims. (Cl. 210-409)

This invention relates generally to strainers and particularly to the cleaning means thereof.

The invention will be found particularly useful in strainers employed in petroleum products pipe lines and oil transmission pipe lines, the screens of which are of a fine mesh and become clogged with solid matter exceedingly difficult to remove.

The general object of this invention is to provide new and improved screen cleaning means for strainers.

A specific object of the invention is the provision of new and improved means to clean the entire area of a cylindrical screen with a relatively small number of concentrated streams of cleaning fluid under high pressure, whereby only a small volume of cleaning fluid is discharged into the screen, and only a small source of hydraulic power is required.

Other objects will hereinafter appear.

The preferred embodiment of the invention is illustrated in the accompanying drawings, wherein:

Figure 1 is a view, partly in section and partly in elevation, of the preferred embodiment of the improved strainer of this invention.

Figure 2 is a view, partly in section and partly in elevation, illustrating the strainer cleaning means enlarged as compared to Figure 1.

Figure 3 is a detailed sectional view of a portion of the cleaning device of this invention, illustrating particularly the preferred construction for imparting rotational and radial movement to the nozzle.

Figure 4 is a sectional view taken on line 4-4 of Figure 3, and illustrates one type of gearing mechanism for imparting rotational and radial movement to the nozzle of the cleaning device.

Figure 5 is a view similar to Figure 4, wherein the parts have moved approximately 120° relative to each other from the position shown in Figure 4.

Figure 6 is a view similar to Figure 4, wherein the parts have moved approximately 240° relative to each other from the position shown in Figure 4.

Figure 7 is a diagram illustrating the relative positions of the parts of the gearing arrangement of Figures 4-6 during its cycles of operation.

Figure 8 is a view illustrating the overlapping paths followed by a particular jet of the nozzle.

Figure 9 is a schematic view illustrating the longitudinal shifting of the streams of fluid from the nozzle by reason of the radial movement of the nozzle with respect to the strainer screen.

In the drawings, the preferred embodiment of the invention is illustrated, wherein a strainer cleaning nozzle N is disposed within a strainer screen 10 mounted in a strainer housing 11. The strainer screen 10 is formed of a mesh material such as wire mesh and is generally of a very fine mesh so that in use for straining or screening out solid material from a liquid, the solid material is accumulated or collected on the inside surface of the screen 10. Such solid material becomes firmly lodged and caked on

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the inside surface of the strainer screen 10 so that it is difficult to remove when it is desired to clean such screen 10. With this invention the nozzle N directs concentrated streams of cleaning or flushing fluid at a high pressure against the solid material on the inside surface of the strainer screen 10, and as will be explained, the nozzle is moved in such a manner that the entire surface of the strainer screen 10 is effectively cleaned. Only a small volume of the cleaning fluid is required with this construction in order to effectively clean the strainer screen and, therefore, the force of the concentrated streams of fluid from the nozzle is not impeded by a large mass of water in the strainer housing.

The strainer screen 10 and housing 11 are preferably of the type shown in Figure 1 wherein the strainer screen is connected to annular support rings 10a which fit within the housing 11. During the straining or screening of solid material from a liquid, the liquid and the solid material therewith flow into the housing 11 through the inlet opening 11a. The solid material is collected on the inside of the screen 10 as the liquid flows out through the outlet opening 11b. During such straining action, the drain opening 11c and the auxiliary drain opening 11d are closed by suitable valves (not shown). When a predetermined quantity of solid material has been collected on the screen 10, the cleaning nozzle N is actuated, as will be explained, to flush the solid material off the screen 10 and out through the drain opening 11c. During such cleaning action, the inlet opening 11a and the outlet opening 11b are closed by suitable valves (not shown), with the baffle 11e on the inlet opening 11a being held closed by gravity when the fluid flow through opening 11a ceases. The housing 11 may be mounted on supports 12 or any similar supporting means.

One form of cleaning nozzle N which may be used is illustrated in Figures 1 and 2, and it includes a pair of hollow arms 14 and 15, each having jet openings or jets 17 therein. The jet openings 17 on the arms 14 and 15 are staggered with respect to each other (Figure 1) so that each jet opening 17 projects a stream which falls in a different circumferential path on the screen 10, whereby the fluid stream from each jet 17 traces a separate path on the screen 10 upon rotation of the nozzle N. At the forward end of the nozzle N, additional jet openings 18 are provided, and such openings 18 are also staggered with respect to each other and each traces a separate circumferential path on the screen 10.

A central tube 20 is formed on the nozzle between the nozzle arms 14 and 15 and such tube 20 has a flanged connection at 21 with a sleeve 22, the purpose of which will be explained hereinafter. The flanged connection 21 and the sleeve 22 are supported on the end of an eccentric hollow shaft 25 (Figure 3) which is supported by an annular support housing 26 which in turn is welded to a removable closure cover 27 on the strainer housing 11. The closure cover 27 is secured to the support housing 26 by an annular weld 28 or similar securing means and it is held on the strainer housing 11 by a removable clamp 30 of known construction so that the closure cap 27 and the housing 26 with the parts connected thereto are rigidly supported by the strainer housing 11 when in the position shown in Figure 1 with the clamp 30 connected, but may be removed therefrom when the clamp 30 is disconnected.

Fluid under high pressure is supplied from a high-pressure fluid source such as a pump (not shown) to an inlet pipe 32 which is in fluid communication with an annular fluid chamber 33 formed in the support housing 26. Openings 34 are provided in the shaft 25 so that fluid may pass from the annular chamber 33 into the bore of the hollow shaft 25 and may flow therefrom into the hollow nozzle N for discharge through the jet open-

ings 17 and 18 onto the screen 10 at an acute angle thereto. It will be observed that the shaft is closed off by a solid substantially cylindrical plug 35 welded to the end of the hollow shaft 25 by an annular weld 36. The fluid in the chamber 33 is prevented from flowing around the exterior of the shaft 25 by annular packing rings 37 and 38 disposed on each side of the chamber 33 (Figure 3). Also, an O-ring seal 39 is provided at the forward end of the shaft 25 to prevent fluid flow around the exterior of the shaft 25 from the bore of the central tube 20 of the nozzle N.

While the water or the fluid is being supplied to the nozzle N from the fluid pressure source, the nozzle N is moved, and such movement is affected by a rotation of the shaft 25 relative to the annular housing 26. The power for the rotation of the shaft 25 is supplied by an electrical motor 40 or other similar driving means secured to the housing 26 by a bracket 41. The motor 40 is connected to suitable gears (not shown) in the gear box 41 for driving a stub shaft 42 (Figure 3) which is keyed at 43 to the solid plug 35 in the end of the shaft 25. With this arrangement, the motor 40 through the gears in the gear box 41 drives the shaft 42 and thereby drives the hollow shaft 25. A ball bearing 45 around the exterior of the plug 35 and an annular bushing or bearing 46 around the exterior of the shaft 25 provide an anti-friction bearing support for the shaft 25 during its rotation.

As best seen in Figure 3, the inner portion 25a of the shaft 25, that is, the portion of the shaft 25 nearest the nozzle N, had its central axis off-set with respect to the central axis of the main portion of the shaft 25. The shaft 25 is thus formed with an eccentric elbow 25b joining the off-set portion 25a to the rest of the shaft 25, thus, when the shaft 25 is rotated the central axis of the main portion of the shaft will remain fixed and will trace a point, but the central axis of the off-set portion 25a will trace a circular path around the axis of the main portion of the shaft 25.

The sleeve 22 is mounted on the forward or inner shaft portion 25a on bushings or bearings 48 and 49 because, as will be explained, during the rotation of the shaft 25, the sleeve 22 rotates relative to the shaft 25 on the off-set shaft portion 25a.

On the end of the sleeve opposite from the flanged connection 21, there is formed an annular gear 50, the teeth of which are adapted to interfit with the openings of a circumferentially disposed chain 52 during the rotation of the hollow shaft 25. The chain 52 is formed of a plurality of links, each of which has a rod 53 extending therefrom and into openings in an inwardly extending radial flange 54 of a clamping sleeve 55. Displacement of the chain 52 from its position (Figure 3) on the clamping sleeve 55 is prevented by washers or flanges 57 on each of the rods 53. The clamping sleeve 55 has a portion thereof surrounding the external surface of the inner end of the annular support housing 26. The sleeve 55 may be held on the housing 26 by numerous means, but preferably several longitudinal slots 58 are formed longitudinally of the sleeve 55 and lugs 59 are provided on each side of the slots 58. A bolt 60 with a nut 61 thereon extends through both of the flanges 59 on each side of each of the slots 58 so that the lugs 59 can be urged toward each other for tightly clamping the sleeve 55 on the housing 26. Thus, with the sleeve 55 held fixed, the chain 52 is likewise held fixed, so that upon rotation of the shaft 25, the teeth of the gear 50 interengage with the links of the chain 52 to cause the sleeve 22 and therefore the nozzle N to rotate relative to the shaft 25.

In Figures 4-6, the effect of the relative rotation between the gear 50 and the chain 52 is illustrated. Assuming that the rotation of the shaft 25 is commenced when the gear 50 and the chain 52 are in the relative positions illustrated in Figure 4, so that the gear tooth A is

in substantially the uppermost position, a rotation of the shaft 25 in a clockwise direction will impart a rotation to the gear 50 in a counterclockwise direction. When the shaft 25 has made one-third of a revolution, the gear 50 has moved to the position shown in Figure 5 which is one-third of a revolution or 120° from the position shown in Figure 4. However, it is to be noted that the tooth A on the gear 50 has not moved one-third of a revolution about the axis of the gear 50. This is due to the particular ratio of the number of openings in the chain 52 to the number of the teeth on the gear 50 as shown in the drawings, wherein there are eighteen openings in the chain 52 and thirteen teeth of the gear 50. The invention, however, is not limited to the particular ratio illustrated, the important thing being that the gear 50 makes a different number of revolutions (or partial revolutions) for each revolution of the shaft 25, whereby a particular tooth, such as tooth A, on the gear 50 will move at a different rate about the central axis of the gear 50 than the entire gear will move in its travel about the central axis of the annular chain 52 or the central longitudinal axis of the hollow shaft 25, the axes of the chain 52 and the shaft 25 being coincident.

In Figure 6, the position of the gear with respect to the chain 52 is illustrated after the shaft 25 has been moved two-thirds of a revolution from the position shown in Figure 4 so as to move the entire gear 50 two-thirds of a revolution or 240° about the central axis of the chain 52 and the central axis of the shaft 25. As can be seen in Figure 5, the tooth A has moved only slightly over 90° about the axis of the gear 50 from the position shown in Figure 4. It is believed apparent that from a comparison of Figures 4-6, upon the complete revolution of the shaft 25, and therefore the complete revolution of the entire gear 50 with respect to the axis of the chain 52, the tooth A on the gear 50 would not return to the position shown in Figure 4 because the gear 50 makes less than one revolution ($\frac{5}{13}$ of a revolution) about its own axis for each revolution of the shaft 25. Thus, with the particular ratio of thirteen teeth on the gear 50 to eighteen openings on the chain 52 as illustrated in the drawings, the tooth A would not return to the position shown in Figure 4 until the shaft 25 has made thirteen revolutions.

Thus, assuming the rotation of the shaft 25 begins when the parts are in the position shown in Figure 4, the tooth A will be in a different position from that shown in Figure 4 at the end of each revolution of the shaft 25, until the shaft has made thirteen complete revolutions. It will also be observed that the tooth A (Figures 4-6) not only moves about the axis of the gear 50, but also moves laterally or radially with respect to the central axis of the chain 52. Since the gear 50 is directly connected to the nozzle N through the central tube 20, the rotational movement of the gear 50 about its own axis, as well as the lateral or radial movement of the gear 50 about the central axis of the chain 52, will be transmitted to the nozzle N so that it is rotated relative to the screen 10 and is also moved laterally or radially relative thereto. The diagram of Figure 7 illustrates the path which a particular point or jet opening on the nozzle N would travel relative to the screen 10 during the corresponding rotation and lateral movement of a particular gear tooth such as tooth A on gear 50. In Figure 7, the solid circle represents the screen 10; the long dash line represents the path which a particular point on the nozzle N would trace for a complete revolution thereof; and the small dash line represents the path which the particular point on the nozzle would trace during its second revolution. For purposes of illustration, it is assumed the particular point selected actually touches the screen 10 at the furthest outward lateral or radial movement thereof. Also, to explain the relationship of the nozzle movement to the movement of the gear 50, it is assumed that said particular point on the nozzle N lies on a line C (Figure 4) ex-

tending radially outwardly from the central axis of the chain 52 through gear tooth A. Thus, when the gear tooth A is in the position shown in Figure 4, the particular point or jet assumed on the nozzle N would be at the starting point F in Figure 7. As the shaft 25 rotates, the particular point or jet moves in path indicated by the long dash line so that when the gear tooth A has moved to the position shown in Figure 5, the particular point or jet on the nozzle will have moved to X (Figure 7). The letter Y (Figure 7) illustrates the position of the particular nozzle point or jet when the gear tooth A has moved to the position shown in Figure 6. As can be seen in Figure 6, the gear tooth A has moved into an opening between the teeth or links of the chain 52 for the first time since rotation from the position of Figure 4; likewise, the particular nozzle point has moved into contact with the screen 10 at Y for the first time since leaving the starting point F. After one complete revolution of the gear tooth A about the axis of gear 50, the particular nozzle point will move to Z, and the long dash line in Figure 7 traced by the selected nozzle point or jet will continue as indicated by the letters F, X, Y and Z until one complete revolution of the gear tooth A about the axis of the gear 50 has been accomplished, at which time the particular nozzle point or jet will be at R (Figure 7). During that revolution of the gear 50 about its own axis and the corresponding revolution of the nozzle N, the shaft 25 turns 2.6 revolutions with the particular ratio of thirteen gear teeth on gear 50 to eighteen openings on chain 52. That results in the gear tooth A and likewise the particular point or jet illustrated in Figure 7 making 3.6 reciprocations, that is, lateral or radial movements corresponding to the movement from F to Y. Thus, for each revolution of the nozzle N, it is reciprocated laterally or radially 3.6 times.

The second revolution of the nozzle N is illustrated by the short dash lines in Figure 7, with the end thereof being designated by the letter R'. At the end of the two revolutions of the nozzle (R'), the nozzle has been reciprocated 7.2 times. It is important to note that at the end of the second revolution (R'), the particular nozzle point or jet is not at the starting point F, but each point R and R' is radially inwardly therefrom. In fact, with the particular ratio of thirteen teeth on gear 50 to eighteen openings on the chain 52, the particular point or jet will not return to point F until the nozzle has made five complete revolutions (corresponds to thirteen revolutions of the shaft 25). Thus, for each of the five nozzle revolutions, a separate path is traced by the particular point on the nozzle. Only two nozzle revolutions have been illustrated in Figure 7 as they are believed sufficient for an understanding of the invention.

The effect of the lateral or radial movement of the nozzle N diagrammatically illustrated in Figure 7 is to cause the concentrated fluid streams from the jets 17 and 18 to move longitudinally back and forth with respect to the screen 10 as the nozzle N is rotated. Such result is schematically illustrated in Figures 8 and 9.

In Figure 9, the nozzle N is shown in solid lines and the long dash lines indicate the streams of fluid issuing from the jet openings when the nozzle is in one position, for example, in the position corresponding to the position of the gears shown in Figure 4. As the nozzle N is moved, when the gear tooth A has completed one revolution about the axis of the gear 50, the nozzle N will also have completed a revolution, but the nozzle will be disposed radially inwardly from the screen 10 as shown in the dotted lines in Figure 9. The extent that the nozzle N is positioned inwardly corresponds with the distance diagrammatically illustrated in Figure 7 between the letters F and R. Because the streams of fluid from the jet are directed at an acute angle to the screen 10, such inward movement of the nozzle N results in the streams being displaced longitudinally of the screen 10, as indicated by the short dash lines in Figure 9. The actual

movement of the concentrated streams of fluid from the openings 17 is in a form similar to a sine wave as illustrated in Figure 8. In Figure 8 the long dash lines indicate the center of one jet stream as it moves through its path on the inside surface of the cylindrical screen 10. Such path has been laid out as it would appear in a flat plane if the inside surface of the screen 10 were laid out in such a plane. The point F in Figure 8 corresponds with the point F in Figure 7 and similarly the points X, Y and Z in Figure 8 correspond with the points X, Y and Z in Figure 7, and therefore the long dash line in Figure 8 represents the path which a particular jet would follow for approximately one complete revolution of the shaft 25 or approximately one-third of the first revolution of the nozzle N. The short dash line in Figure 8 represents the path which the same jet illustrated in Figure 8 by the long dash line would travel during the second revolution of the particular gear tooth A about the axis of the gear 50. At the beginning of the first revolution of the gear tooth A from the position shown in Figure 4, the particular jet nozzle whose path is illustrated in Figure 8 would have moved from F to X which as indicated in Figure 7 would be a movement that radially inwardly toward the center axis of the gear chain 52. However, when the gear tooth A has completed one revolution about the axis of the gear 50, the particular nozzle which is moved in the path from F to X will now start its movement at the point R and therefore will be moving radially away from the center of the gear chain 52, and thus the short dash line in Figure 8 represents approximately one-third of the second revolution of the same jet stream path indicated by the long dash line and, as is evident, such second path crosses the first path. All of the numerous crossing paths which a particular jet would follow in the complete cycle of thirteen revolutions of shaft 25 are of course not illustrated in Figure 8, but at the beginning of each revolution of the gear 50, the particular jet illustrated in Figure 8 would start its path from a different longitudinal point with respect to the strainer 10 and therefore there will be five different paths followed by the same jet during the cycle of thirteen revolutions of the shaft 25, which results in an effective path I.

It is also important to note that the arm 14 is 180° from the arm 15. As previously mentioned, since the jets 17 on arm 14 are staggered with respect to the jets 17 on the arm 15, the paths of the fluid streams traced on the screen 10 by the jets 17 on the arms 14 and 15 are staggered; for example, with the forward jet 17 on the arm 14 tracing a fluid stream path on the screen, the next adjacent path is traced by the forward jet 17 on the arm 15, and the next adjacent path is traced by the second jet 17 on the arm 14, and so forth. By reason of that staggering and the location of the arms 14 and 15 spaced from each other 180°, the adjacent fluid stream paths will interlace as indicated in Figure 8, wherein the effective path of a jet on the arm 14 is designated by the numeral I and the effective path of a jet on the arm 15 is designated by the numeral II. As can be seen in Figure 8, the widest parts of the effective path I occurs adjacent the narrowest parts of the effective path II and conversely, the narrowest parts of the effective path I are adjacent the widest parts of the effective path II. Such interlacing of the adjacent paths of the jets on the arms 14 and 15 result in a complete washing and cleaning action of the interior surface of the screen 10 with less jets than would be required if all the jets were on the same nozzle. It will also be appreciated that each fluid stream path of the effective path I, two of which are indicated by the long dash line and the short dash line, would be a band rather than a line because the fluid discharging from each jet diverges as it moves toward the screen 10, so that there is an overlapping of the stream paths making up the effective path I. Similarly, the solid lines indicating two of the stream paths of the effective path II are actually bands which overlap each other.

Also, because of the interlacing of the adjacent effective paths as above described, there will be an overlapping of some of the fluid stream bands in adjacent effective fluid paths whereby complete washing action on the entire interior surface of the screen 10 is assured.

With the construction of this invention, it is believed apparent that effective cleaning of the surface of a strainer screen can be accomplished while using a minimum number of jets discharging concentrated streams of fluid on such surface, whereby only a small source of hydraulic power is required and also only a small volume of cleaning fluid is discharged onto the screen. It is particularly important that a small volume of the cleaning fluid be discharged onto the screen because if such a large quantity of the cleaning fluid were discharged as to accumulate within the strainer, the force of the jet would be impeded because they would have to pass through the mass or body of water in the strainer. Thus, since relatively small streams can be utilized in this invention for cleaning a relatively large surface area of the strainer screen, the amount of hydraulic power required is reduced and likewise a smaller volume of fluid is required for effectively cleaning the screen.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and material, as well as in the details of the illustrated construction may be made within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed is:

1. In a strainer adapted to collect solid material, a cleaning nozzle, a strainer screen surrounding said nozzle, a rotatable shaft having a portion thereof offset with respect to the shaft, means connecting the offset portion of said shaft to said nozzle, said shaft and said nozzle having a fluid passage therein for conducting fluid through the shaft to the nozzle for discharge from the nozzle at high pressure upon the surface of the screen, an annular gear connected to said nozzle and surrounding said offset portion of the shaft, and an internally toothed gear surrounding said annular gear and adapted to interfit therewith during the rotation of said shaft, whereby upon rotation of said shaft, the intermeshing of said annular gear with the circular internally toothed gear effects a rotation of the nozzle in a direction opposite to the direction of rotation of the shaft.

2. The structure set forth in claim 1, wherein the annular gear has a different number of teeth than the number of openings between the teeth of the circular external gear, whereby the annular gear and the nozzle are moved at a different rotational rate than the shaft.

3. A strainer having a substantially cylindrical screen, a nozzle having a plurality of openings to discharge a stream of cleaning fluid upon said screen, means to move said nozzle openings across and toward and away from said screen, and means for automatically controlling the time at which said nozzle openings are moved toward and away from said screen during each movement of said nozzle openings across said screen so that upon successive movements of said nozzle openings across said screen the place of impact of said stream on said screen is varied to thereby wash a relatively large area of said screen under controlled conditions.

4. A strainer having a substantially cylindrical screen, a nozzle, means causing said nozzle to discharge a stream of cleaning fluid upon and at an acute angle to the interior surface of said screen, and means serving to impart a hypocycloidal motion to said nozzle to widen axially the area upon which the fluid is being discharged.

5. A strainer having a substantially cylindrical screen, a nozzle having a plurality of openings disposed within said screen to discharge a plurality of streams of cleaning fluid at an axially acute angle to the interior surface of said screen, and means for rotating said nozzle and screen relative to each other about a longitudinal

axis of the screen and for moving the openings radially with respect to said axis.

6. A strainer having a substantially cylindrical screen, a nozzle having a plurality of openings disposed within said screen to discharge a plurality of streams of cleaning fluid at an axially acute angle to the interior surface of said screen, and means for rotating said nozzle and screen relative to each other about a longitudinal axis of the screen and for reciprocating the openings radially with respect to said axis, said reciprocation and rotation being at different frequencies.

7. A strainer having a substantially cylindrical screen, a nozzle having a plurality of openings disposed within said screen to discharge a stream of cleaning fluid at an axially acute angle to the interior surface of said screen, means for rotating said screen and nozzle relative to each other about a first axis, and means for rotating said nozzle about a different axis extending in the same general direction as the first axis, said two rotational movements being at different frequencies.

8. Apparatus comprising, a circular member to be cleaned, a nozzle having a plurality of openings disposed within the member, means mounting the nozzle for rotation about a first axis to discharge a stream of cleaning fluid at an acute angle to the interior surface of the member, and means for rotating said member and nozzle relative to each other about a second axis substantially parallel to but different from said first axis, said two rotational movements being at different frequencies.

9. Apparatus comprising, a member to be cleaned, a nozzle having a plurality of openings disposed within the member, means for moving the nozzle within the member in a closed path, and means for rotating the nozzle as it travels in the closed path, said rotation and movement of the nozzle being at different frequencies.

10. Apparatus comprising, a member to be cleaned, a nozzle within the member and having a plurality of openings disposed to discharge a stream of cleaning fluid at an acute angle to the interior of the surface of the member, means for rotating said member and nozzle relative to each other, and means for reciprocating the openings toward and away from the interior surface of the member, said rotation and reciprocation being at different frequencies.

11. Apparatus comprising, a nozzle, means for moving said nozzle in a closed path, means for rotating said nozzle as it travels said path, and a plurality of openings in the nozzle spaced from its axis of rotation and having their central axes disposed at an acute angle to said axis of rotation, said rotation and movement of the nozzle being at different frequencies.

12. A strainer having a substantially cylindrical screen, a nozzle having a plurality of openings disposed to discharge a stream of fluid at an axially acute angle to the interior surface of said screen, means to move said nozzle in a substantially circular path, means to rotate said nozzle on its own axis as it travels said circular path to reciprocate the openings toward and away from the strainer, and means to automatically vary the relationship between the movement of said nozzle in said circular path and the movement of said nozzle about its own axis.

13. A strainer having a substantially cylindrical screen, a nozzle having a plurality of openings adapted to discharge a stream of cleaning fluid upon said screen at an acute angle to the screen, means to rotate said nozzle relative to said strainer screen, and means for moving said nozzle openings toward and away from the axis of said rotation so as to move the point of impact of said stream of fluid longitudinally with respect to said screen during the rotation of the nozzle without longitudinal movement of said nozzle, said rotation of the nozzle and movement of the nozzle openings being at different frequencies.

14. The structure set forth in claim 13, wherein said nozzle has one arm with jet openings therein and a sec-

ond arm also with jet openings therein, said second arm being disposed 180° from said first arm, and said jet openings on said second arm being staggered with respect to the jet openings on said first arm, whereby the paths of adjacent streams from the jet openings interlace with each other to clean the surface of the screen.

15. A strainer having a substantially cylindrical screen, a nozzle having means for discharging a concentrated stream of cleaning fluid at an acute angle upon the surface of said screen, actuating means to move said nozzle in a rotational direction and said discharging means in a radial direction relative to said rotation simultaneously to trace a predetermined path with the stream of fluid as it contacts the surface of said screen, and means to automatically vary the movement of said discharging means during the rotation of the nozzle for effecting a crossing of the predetermined paths of the stream for each revolution of the nozzle.

16. The structure set forth in claim 15, wherein said nozzle has one arm with jet openings for discharging concentrated streams of cleaning fluid at an acute angle upon the surface of said screen and a second arm also having jet openings for discharging concentrated streams of cleaning fluid at an acute angle upon the surface of said screen, said second arm being disposed 180° from said first arm, and said jet openings on said second arm being staggered with respect to the jet openings on said first arm, whereby each of the fluid streams from said openings trace crossing paths on the screen, the adjacent fluid stream paths from the staggered jets interlace with each other.

17. A strainer having a cleaning nozzle, a strainer screen surrounding said nozzle, said nozzle having a plurality of jet openings adapted to discharge concentrated streams of fluid at high pressure at an acute angle to the surface of said strainer screen, a shaft having an off-set portion, means for rotating said shaft, means connecting the off-set portion of said shaft to said nozzle for rotating

the nozzle with the shaft and for effecting a rotation of the nozzle about the off-set portion of the shaft at a different frequency during the rotation of the shaft, whereby the streams of fluid issuing from the jet openings of the nozzle are moved longitudinally with respect to the surface of the strainer screen during the rotation of the nozzle.

18. The structure set forth in claim 17, wherein said nozzle has one arm with jet openings therein and a second arm also with jet openings therein, said second arm being disposed 180° from said first arm, and said jet openings on said second arm being staggered with respect to the jet openings on said first arm, whereby the paths of adjacent streams from the jet openings interlace with each other to clean the surface of the screen.

19. A strainer having a housing with a fluid inlet opening, fluid outlet opening and a drain opening, a screen mounted in said housing, a nozzle having a plurality of openings to discharge a stream of cleaning fluid upon said screen at an acute angle for discharge through said drain opening, and means for rotating said nozzle and screen relative to each other about a longitudinal axis of the screen and for reciprocating the openings radially with respect to said axis, said reciprocation and rotation being at different frequencies.

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