United States Patent

[11] 3,559,794

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[73] Assignee **Taylor-Wilson Manufacturing Company**
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[54] **METHOD AND APPARATUS FOR HANDLING ELONGATED WORKPIECES THROUGH A PROCESS AREA**
21 Claims, 19 Drawing Figs.

[52] **U.S. Cl.** **198/19,** 198/31

[51] **Int. Cl.** **B23q 7/00**
[50] **Field of Search** 198/19.22, 31.1A, 103, 104; 214/1P, 1P2; 118/423

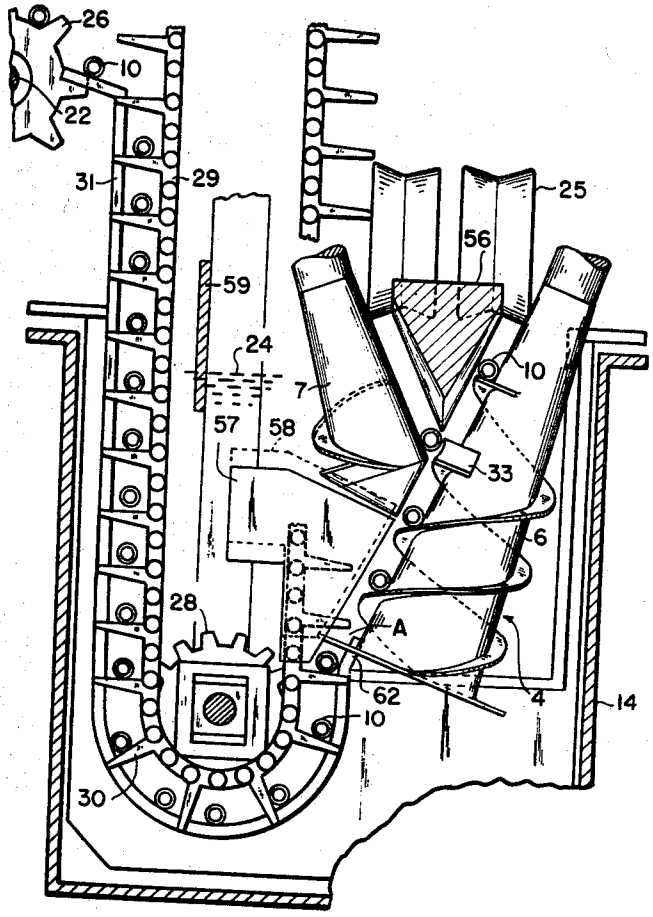
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Primary Examiner—Andres H. Nielsen
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ABSTRACT: An automatic processing line having a conveyor system continuously feeding workpieces to chain sinkers which lower the workpiece into a process area at a slope and raise the workpiece from the process area at a slope and a screw apparatus which removes the workpiece from the chain sinker in the process area and conveys it to a continuous dragout conveyor for removal.



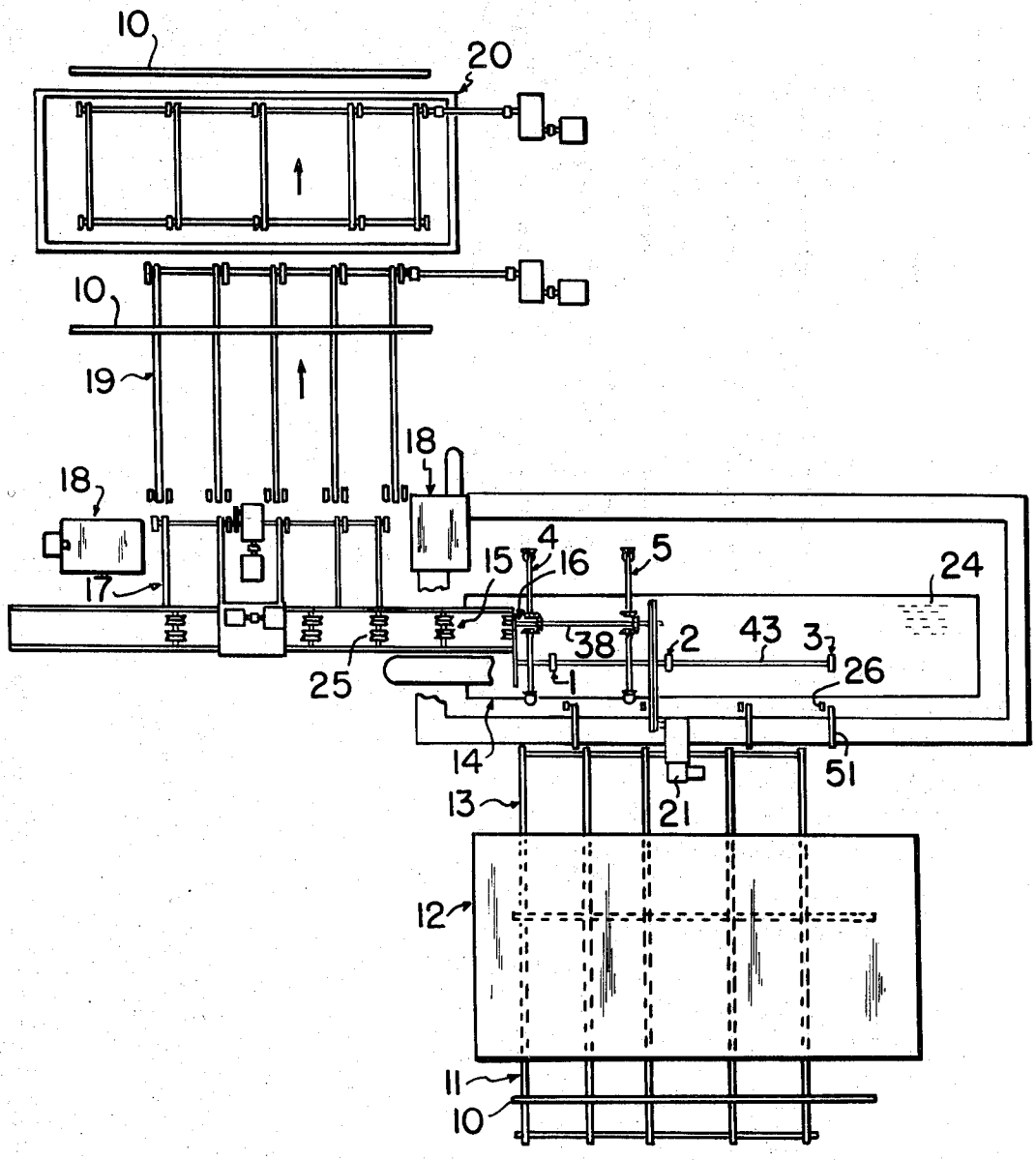


Fig. 1

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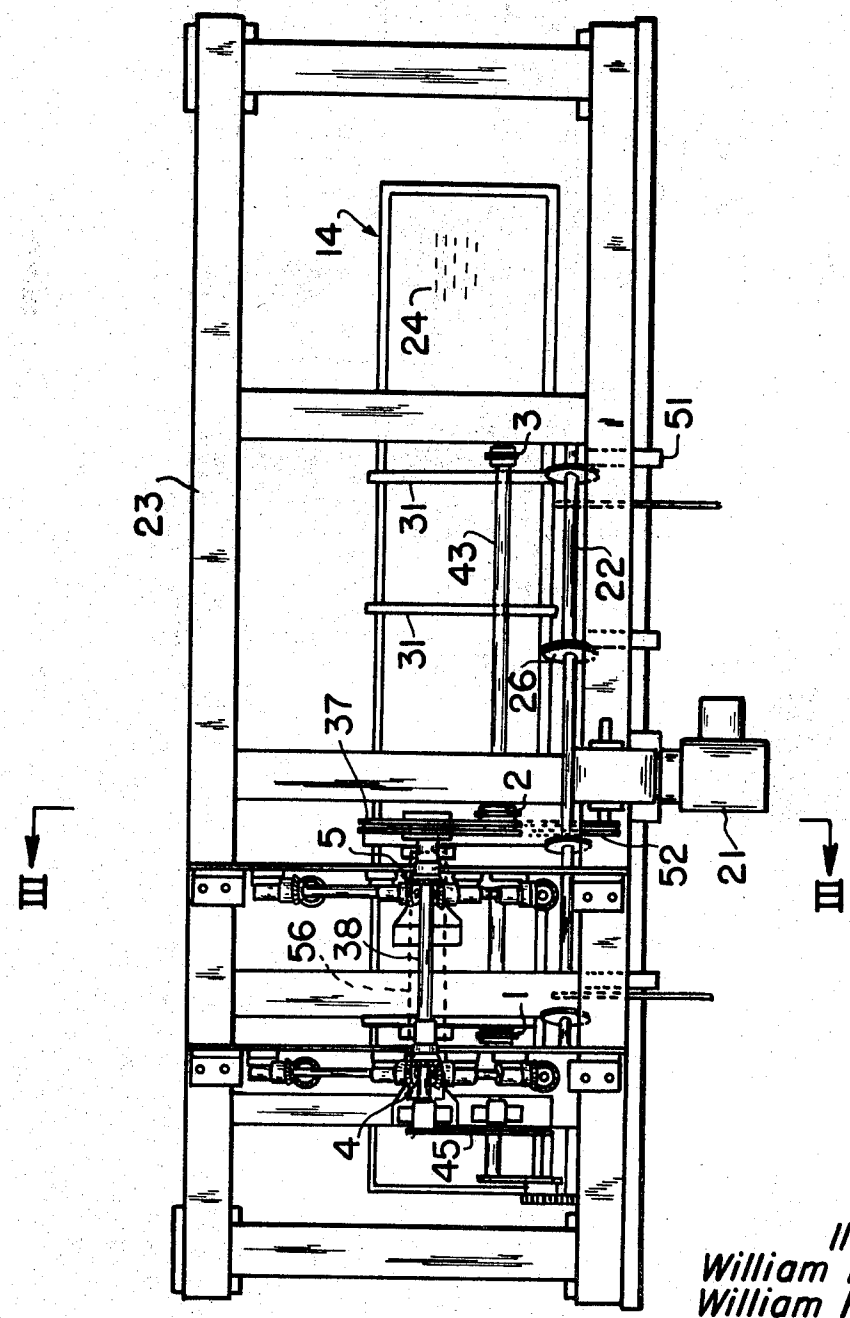


Fig. 2

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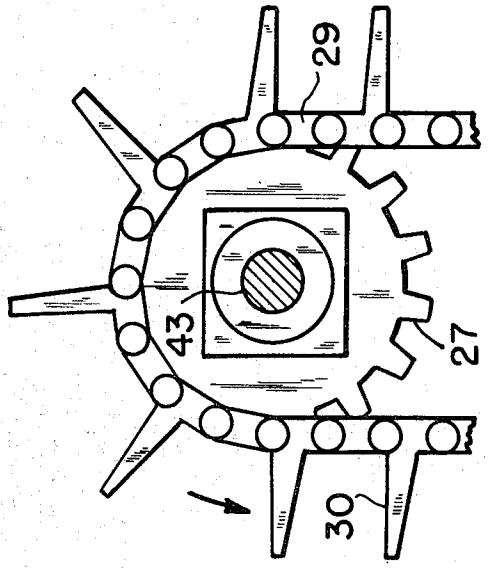


Fig. 4

Fig. 3

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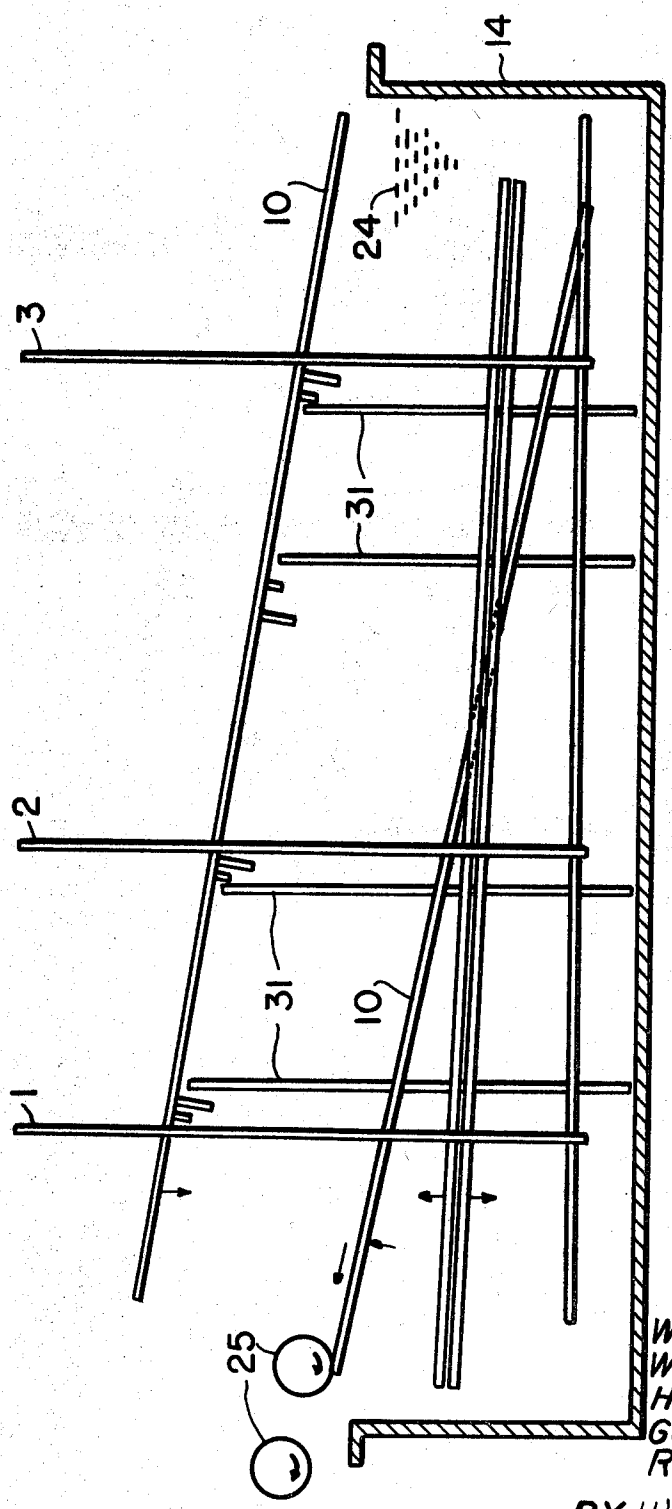


Fig. 5

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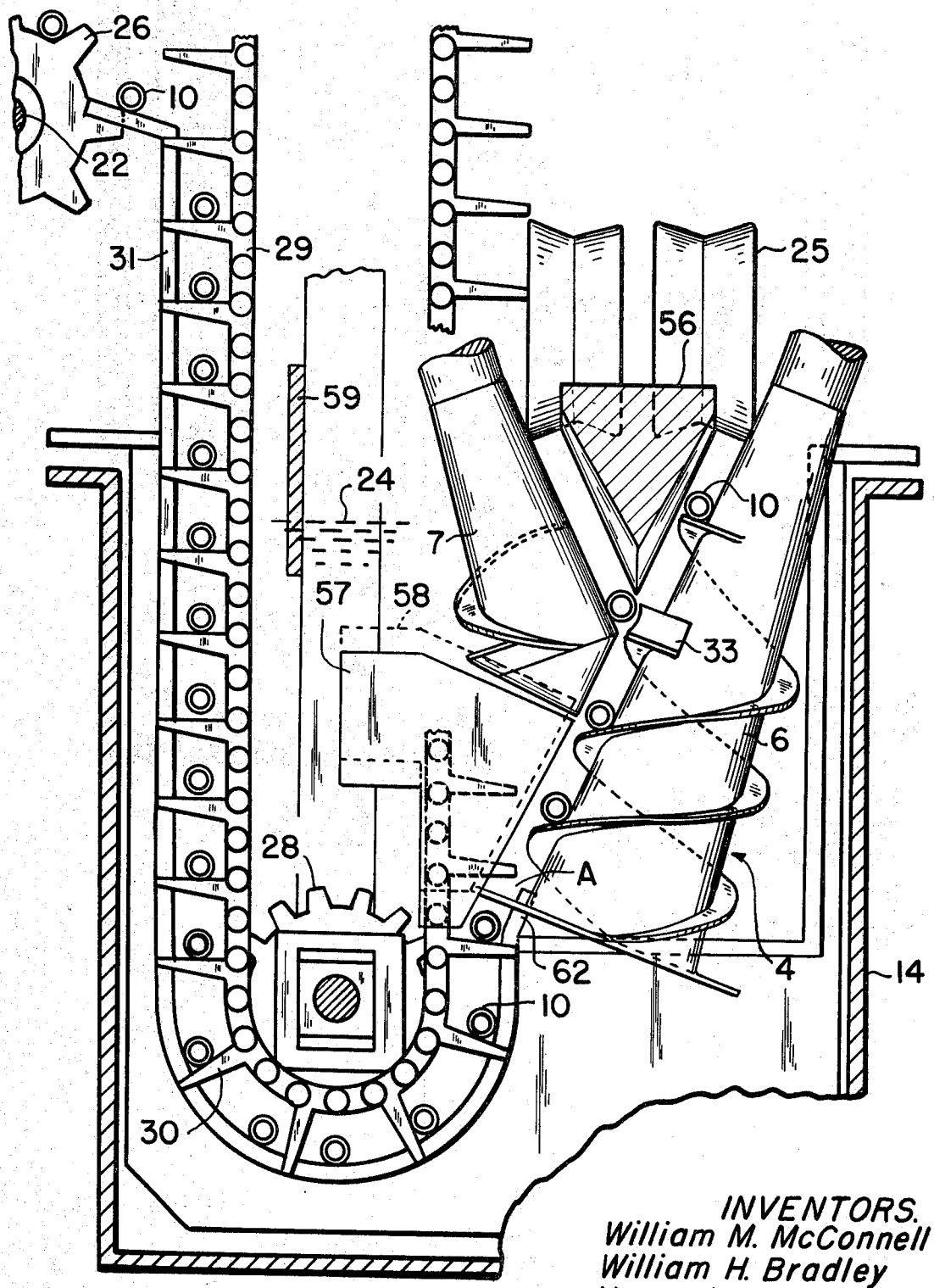


Fig. 6

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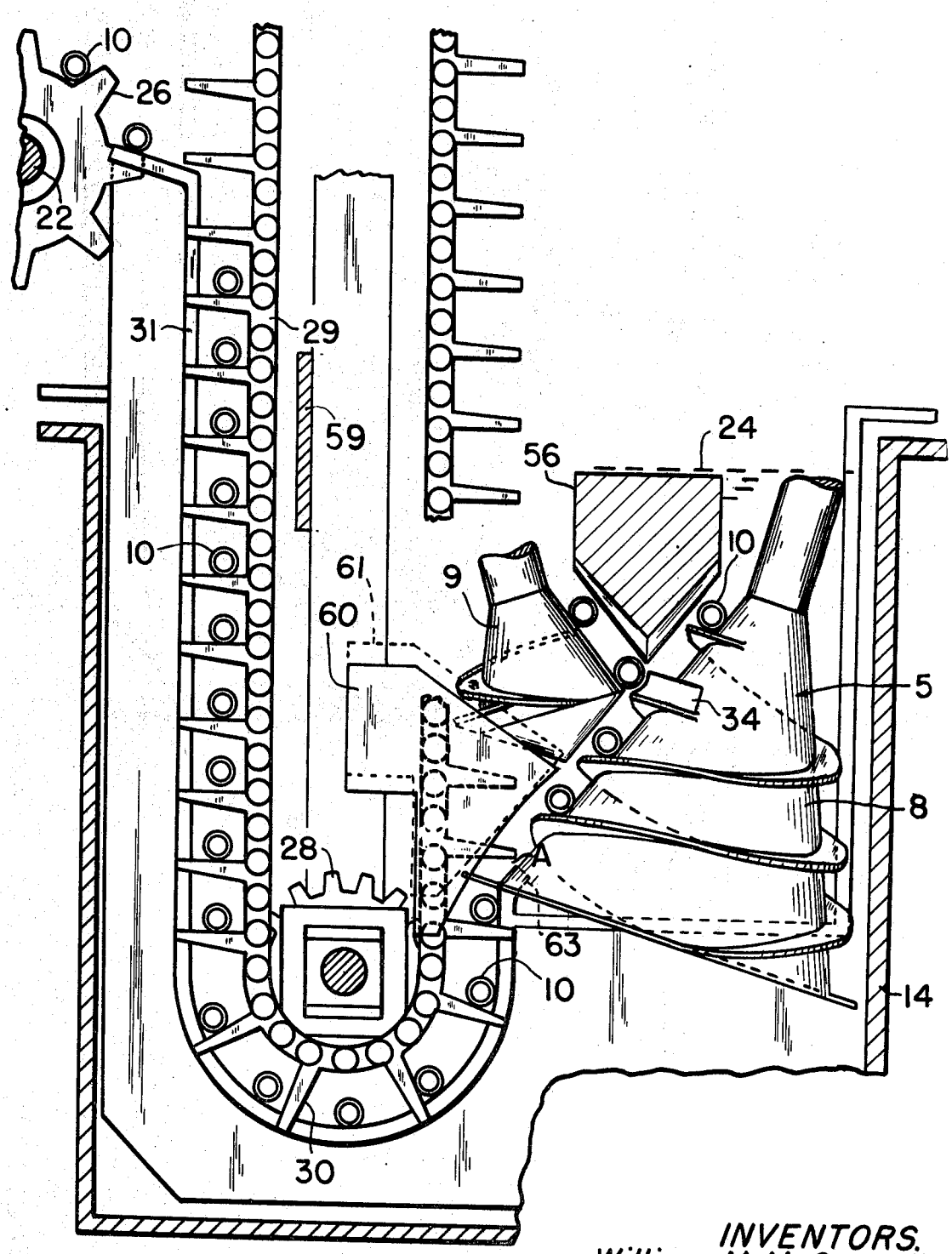


Fig. 7

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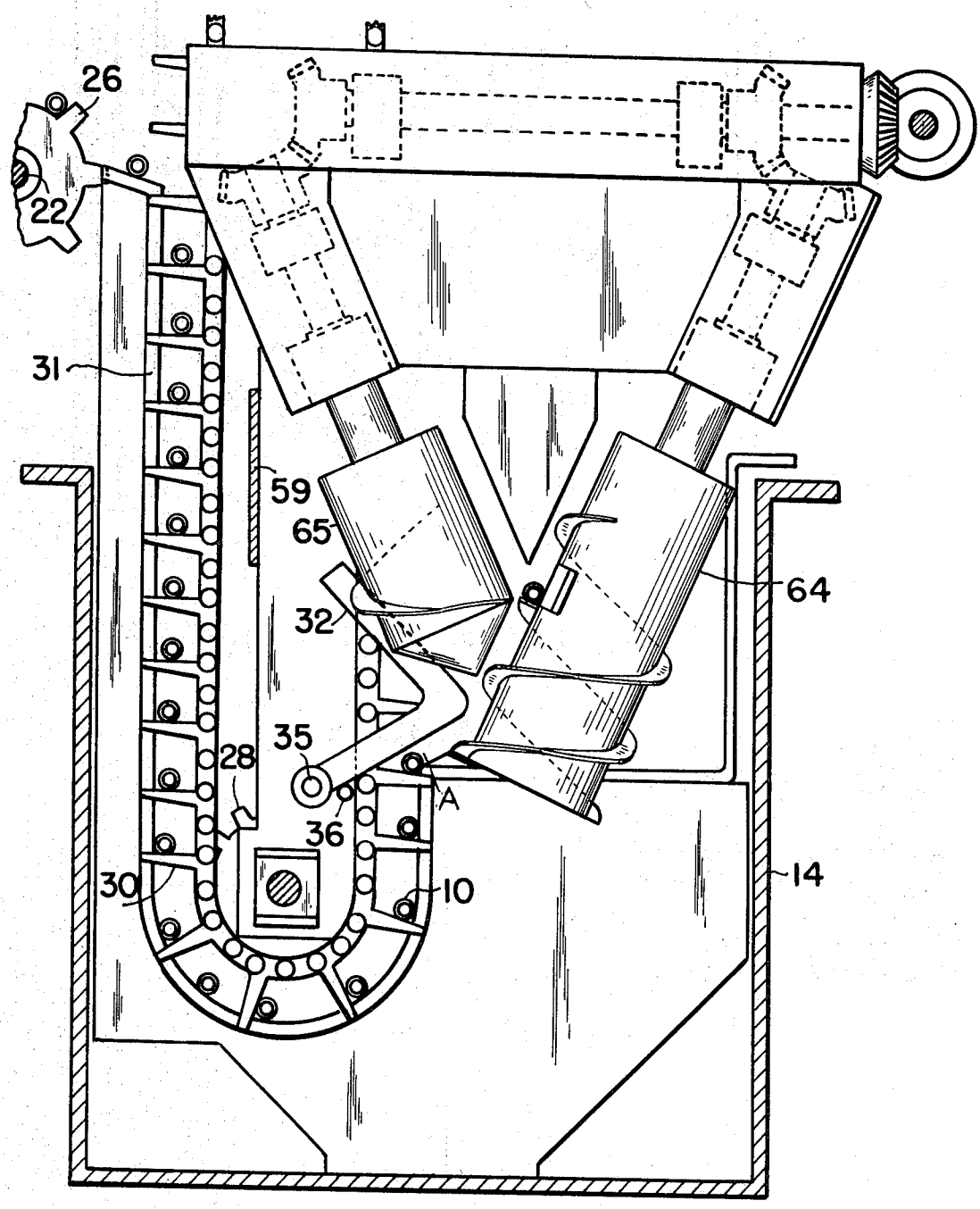


Fig. 8

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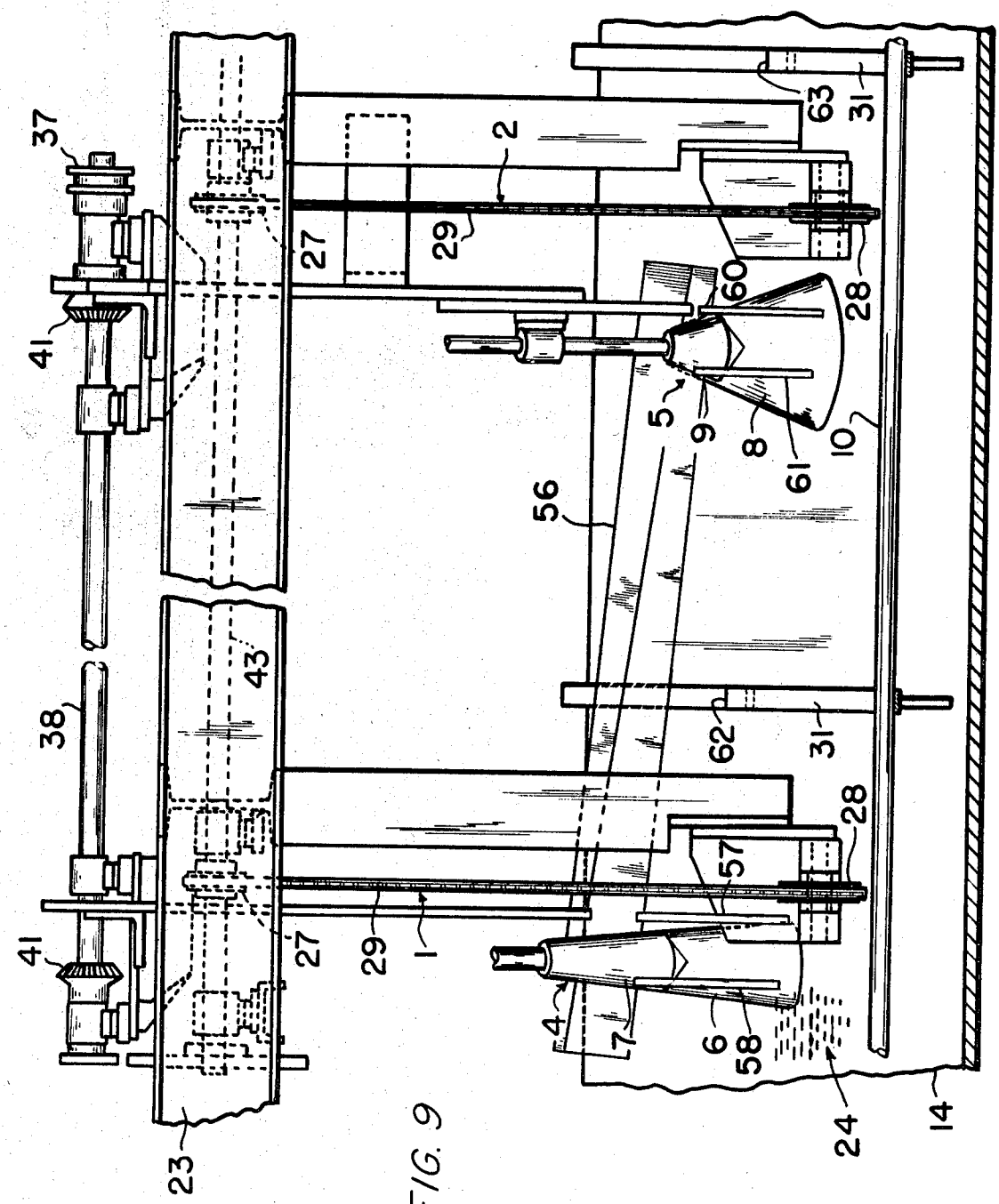


FIG. 9

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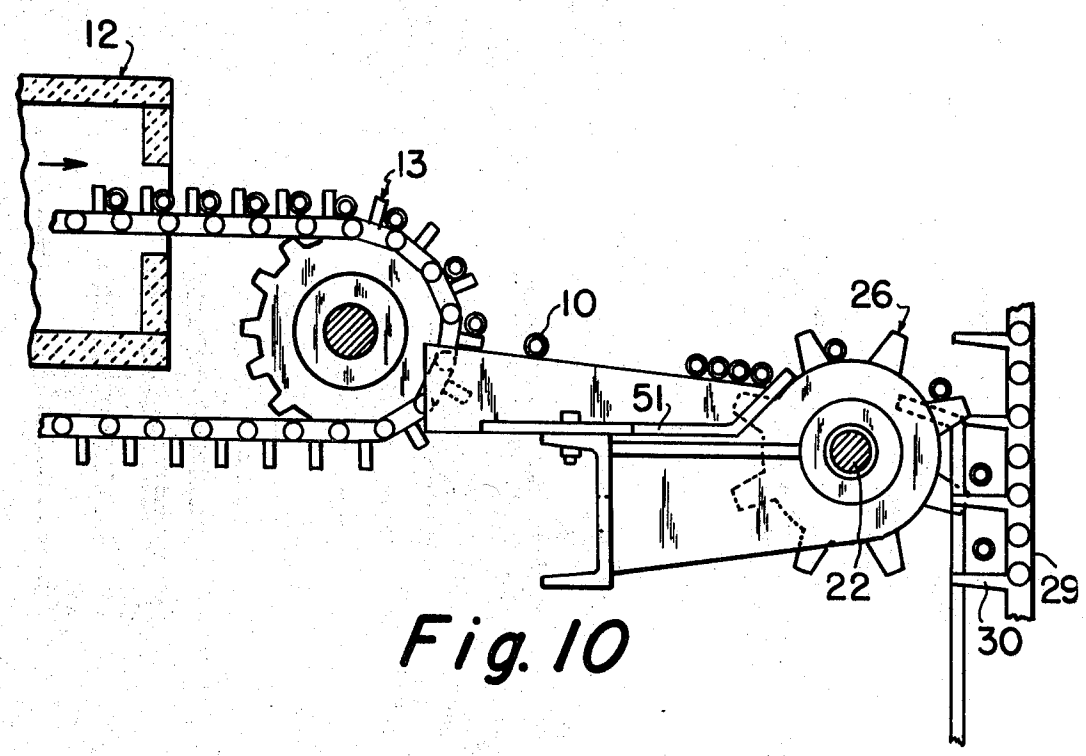


Fig. 10

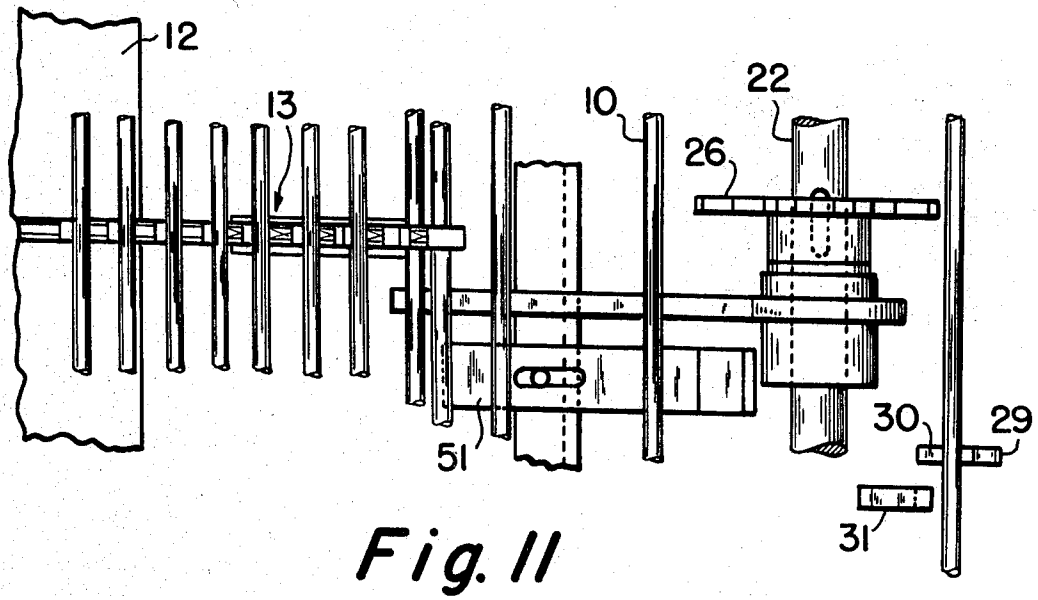


Fig. 11

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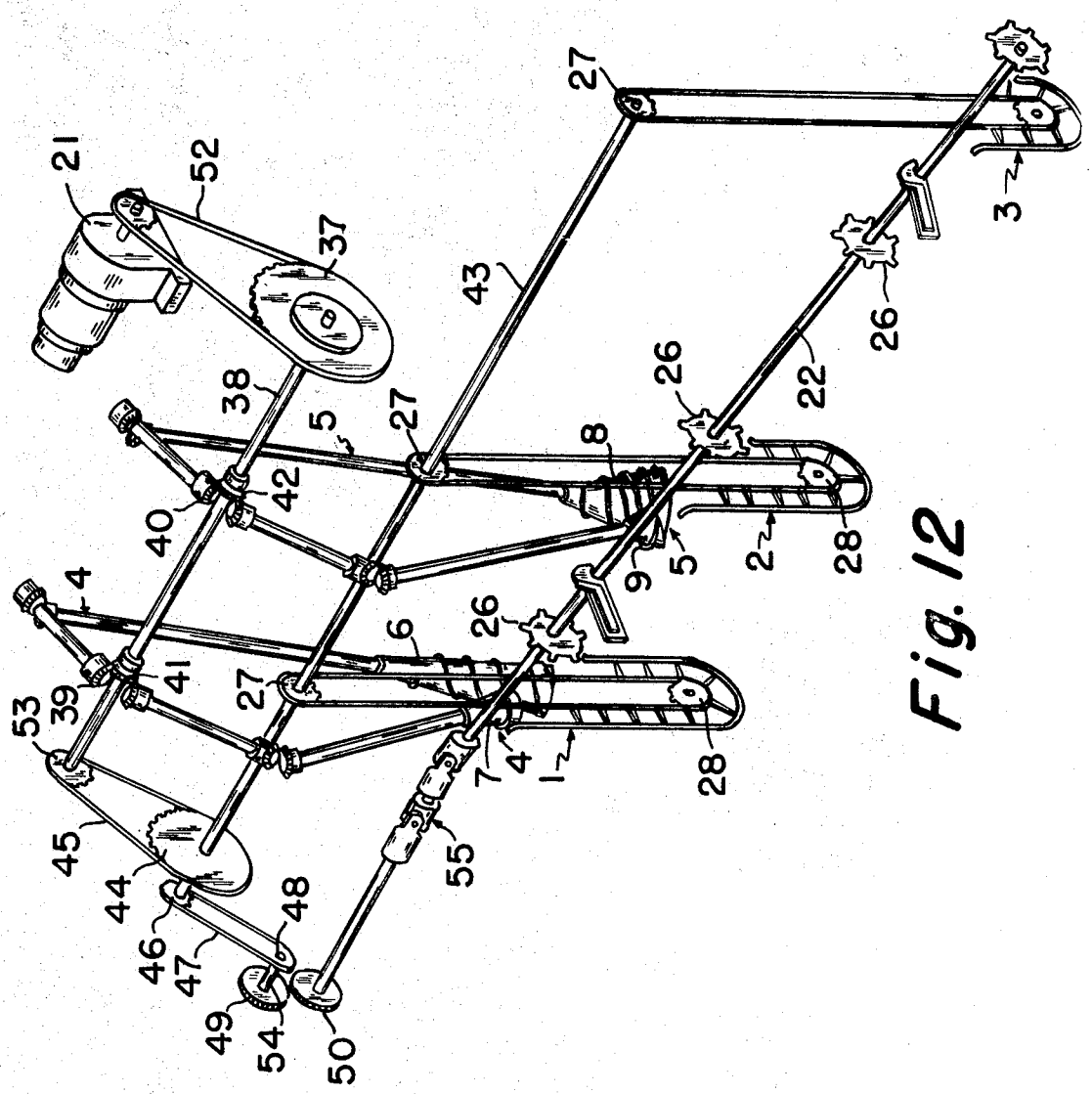


Fig. 12

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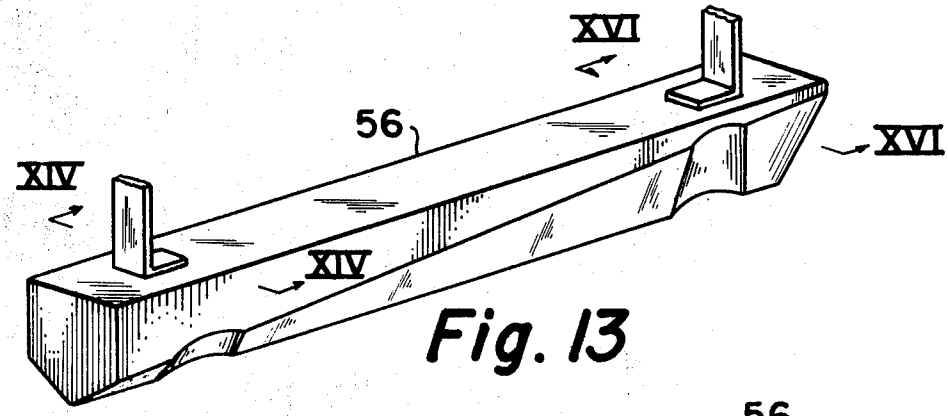


Fig. 13

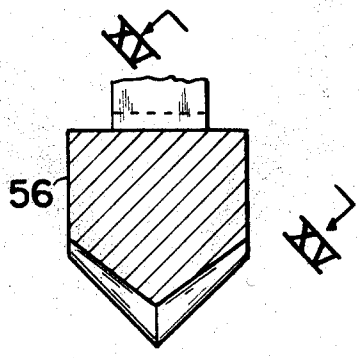


Fig. 14

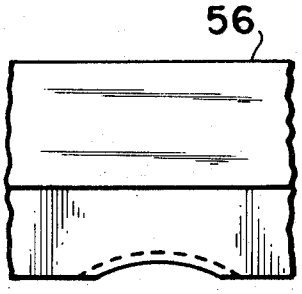


Fig. 15

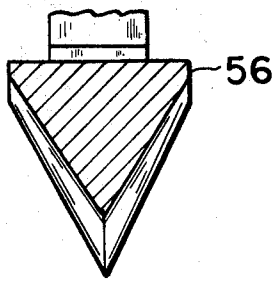


Fig. 16

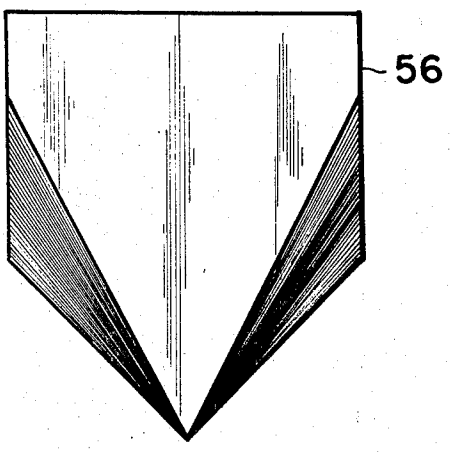


Fig. 17

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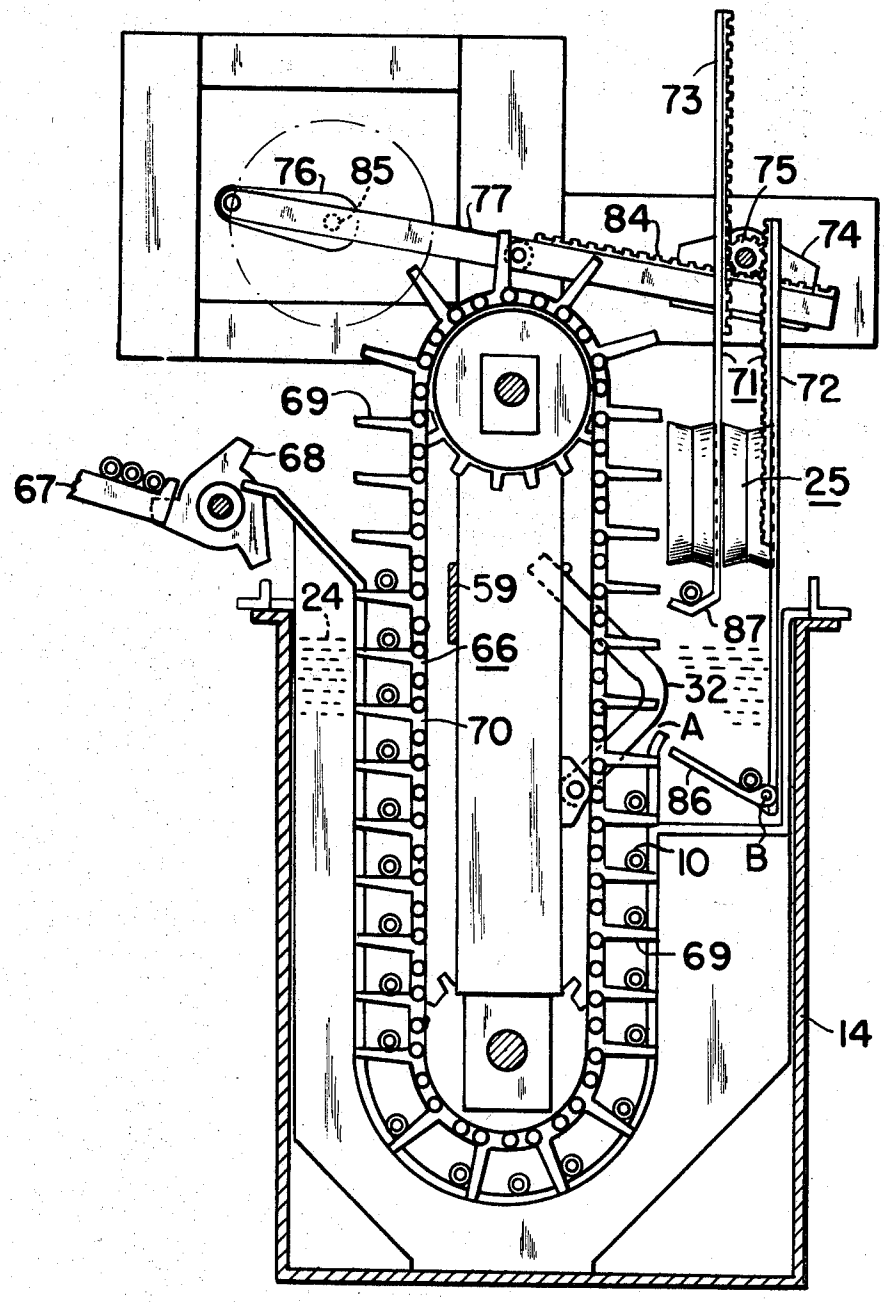


Fig. 18

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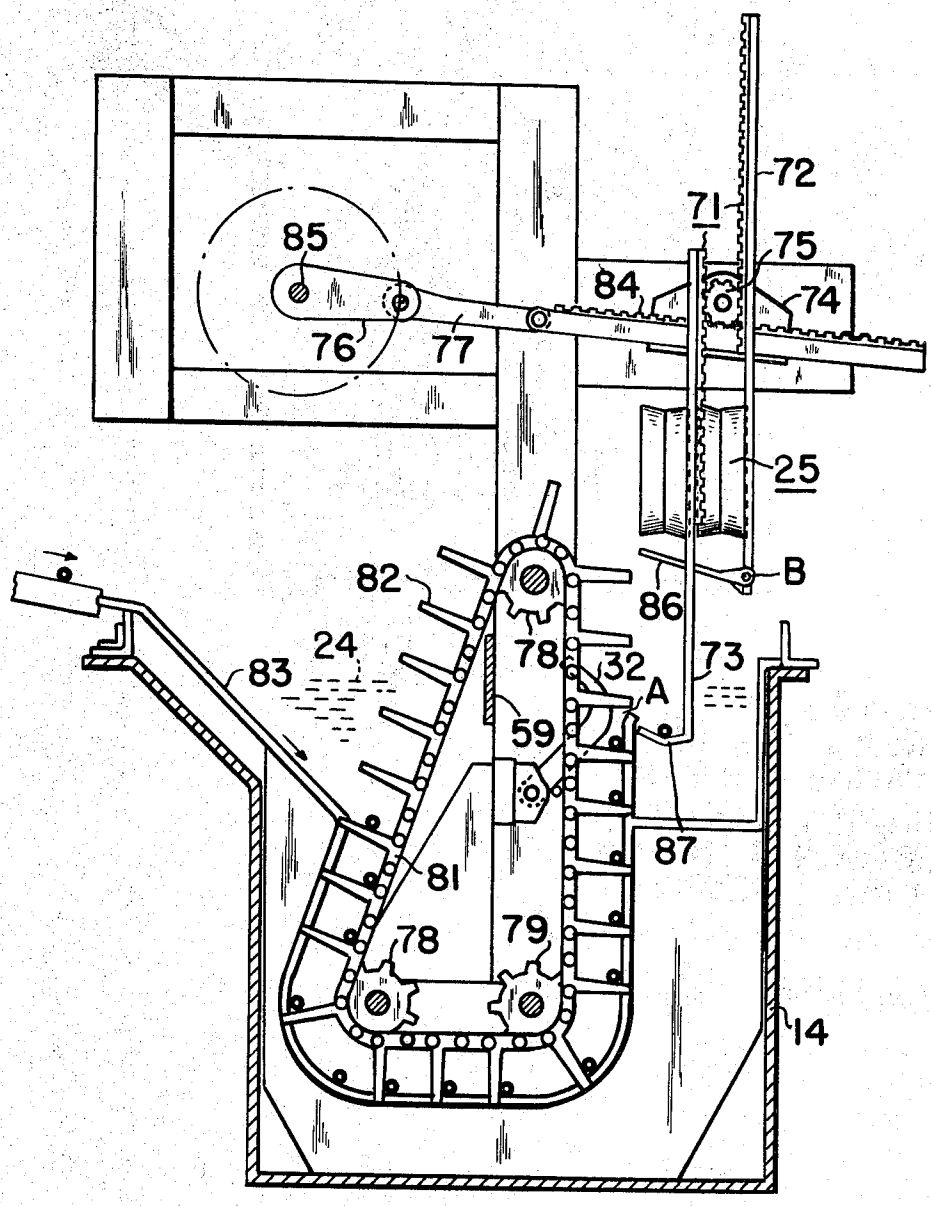


Fig. 19

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METHOD AND APPARATUS FOR HANDLING ELONGATED WORKPIECES THROUGH A PROCESS AREA

SPECIFICATION

Our invention relates to an automatic processing line for treating workpieces by either one of or a combination of metal coating, pickling cleaning with liquid or vapor, coating with paint, plastic, etc., by liquid or vapor or plating of any type. More particularly, our invention relates to an automatic metal coating apparatus for pipe and still more particularly our invention relates to an apparatus continuously conveying lengths of pipe into a molten zinc pot for continuous galvanizing and then removing them for further processing.

Our invention provides for the continuous controlled feeding of a workpiece through a process area in such manner that the first workpiece in is the first workpiece out. Because of this first in-first out principle, the process is very controllable for providing identical processing to an infinite number of successive workpieces. For example, where metal coating is the particular process, the length of time a workpiece remains in the process area can be kept constant for all successive workpieces resulting in a uniform coating weight for all the workpieces. In addition, our invention provides for lowering the workpiece into the process area at an angle with respect to the liquid or vapor bath therein contained for ease of liquid or vapor displacement and proper air venting. It also provides for reducing the inclination of the workpiece to zero at the bottom of the liquid or vapor bath for proper processing and then moving the workpiece angularly for removal from the bath so that the excess liquid will properly drain back into the bath. Our invention also provides a method for easily removing the workpiece from the processing conveyor apparatus and delivering alternate workpieces to an alternate parallel system of dragout conveyors to then be conveyed for further processing. It also provides for continuously feeding just one of the alternate systems of dragout conveyors if for some reason it becomes necessary or desirous to not operate the other.

Various other features, objects, and advantages of the automatic processing apparatus will either be specifically pointed out or become apparent when, for a better understanding of the invention, reference is made to the following description taken in conjunction with the accompanying drawings illustrating a preferred embodiment of the invention. In the drawings:

FIG. 1 is a schematic view showing the material flow and general arrangement of a galvanizing unit embodying our invention;

FIG. 2 is a plan view showing the general arrangement of a unit embodying our invention;

FIG. 3 is a schematic view taken along section lines III–III of FIG. 2, showing one sinker chain assembly and one screw roll assembly;

FIG. 4 shows a cutaway view of the upper portion of chain assembly 2;

FIG. 5 is a schematic view showing the relative inclination of the pipe during ascent and during descent;

FIG. 6 is a section showing the movement of pipe on the screw roll assembly having the long flight;

FIG. 7 is a section showing the movement of pipe on the screw roll assembly having the short flight;

FIG. 8 is a section showing an alternative screw roll assembly comprised of straight rolls;

FIG. 9 is an elevation showing both screw roll assemblies;

FIG. 10 is an elevation showing the feeding of pipe from the starwheel onto a sinker chain;

FIG. 11 is a plan of FIG. 10;

FIG. 12 is an isometric of the common drive means;

FIG. 13 is an isometric of the elongated confinement guide;

FIG. 14 is a section taken along section lines XIV–XIV of FIG. 13;

FIG. 15 is a section taken along section lines XV–XV of FIG. 14;

FIG. 16 is a section taken along section lines XVI–XVI of FIG. 13;

FIG. 17 is an end view of FIG. 13, looking from the left end to the right end, showing the curvature of the sides which intersect to form the V-portion of the guide;

FIG. 18 is a schematic view of a sinker assembly and a reciprocating cradle assembly; and

FIG. 19 is a schematic view of a treble sprocket sinker chain assembly and a reciprocating cradle assembly.

A schematic showing the general arrangement of a complete galvanizing unit embodying our invention is shown in FIG. 1. As can be seen, a cut length pipe 10 to be coated is placed in an entry conveyor 11. This cut length pipe could be any form of workpiece such as rods, conduit, bars, structural members, tubing, etc. The term workpiece as used herein describes any such length of pipe or any other equivalent which would be subjected to any of the various processes herein disclosed. The entry conveyor delivers the pipe into a preheat and drying furnace 12. This preheat and drying furnace could, of course, be any type of preparation station prior to a cleaning, pickling, coating, or plating operation. The pipe then feeds from a pickoff 11 in the furnace 12 and onto an inclined delivery conveyor 13 which delivers the pipe to the coating pot 14 for galvanizing. The pickoff 11 and the inclined feeder conveyor may be one continuous inclined conveyor through the furnace. As disclosed earlier, the process area can be of many types wherein a workpiece is to be treated by metal coating, pickling, cleaning with liquid or vapor, coating with paint, plastic, etc., by liquid or vapor or plating of any type. Our invention, shown in part in FIG. 1, relates particularly to the means for conveying the pipe from the delivery conveyor 13 into the zinc bath 24 and out of the bath 24 to a dragout station 16. The coated pipe is conveyed by a dragout conveyor 15 from the dragout station 16 to another conveyor 17 running normal to the dragout conveyor 15. This conveyor 17 delivers the pipe to a blowout station 18 where all excess zinc is removed. From the blowout station 18, the pipe is conveyed by conveyor 19 to a cooling and bosh tank 20 which completes the galvanizing operation. A rust inhibiting chemical treatment such as the application of dichromate is often employed in the final stages of processing although such treatment is not shown in FIG. 1. These final process stations could be of any type compatible with the particular operation being performed. Motor 21 serves as the common drive means for all operations from the delivery conveyor to the dragout conveyor.

In our preferred embodiment there are three sinker chain assemblies 1, 2, and 3. The sinker chain assemblies, which are parallel and vertical, are spaced within the coating pot 14 and are aligned with the inclined delivery conveyor 13. Only the feed shaft 22 of the delivery conveyor is shown in FIG. 2. As will be seen later, the conveyor is positioned to feed the pipe from above the top of the coating pot 14. The two screw roll assemblies 4 and 5 are located immediately adjacent to sinker chain assemblies 1 and 2, respectively, with sinker chain assembly 1 being between the screw roll assemblies.

The relationship between a sinker chain assembly and a screw roll assembly can best be seen by referring to FIG. 3 which is a schematic view taken along lines III–III of FIG. 2 showing screw roll assembly 5 and sinker chain assembly 2. Each sinker chain assembly is individually mounted to the framework 23 located above the pot. As seen in FIG. 3, the chain assembly 2 extends from the framework 23 above the pot 14 downwardly into the metal bath 24 to a point near the bottom of the pot 14. As will be seen later, the sinker chain assemblies provide the means for transporting the pipe from the feed conveyor downwardly into the bath for coating and then upwardly for removal from the bath. The screw roll assembly 5, consisting of two aligned screw rolls 8 and 9, also extends from the framework 23 above the galvanizing pot 14 downwardly into the metal bath to a predetermined liftout point A where the pipe is removed from the sinker chain by the screw roll assembly. Immediately above and operably aligned with the two screw rolls is a magnetic dragout con-

veyor 25 (shown in FIG. 6) of the type well known to those skilled in the art and which is used for the endwise removal of the pipe from the screw roll assemblies 4 and 5 (only screw assembly 5 is shown in FIG. 3) and from the galvanizing pot 14. Although a magnetic dragout conveyor is employed in our preferred embodiment, any type of removal system may be employed which would be compatible with the particular process in operation. As will be discussed later, the star wheel 26, shown in FIG. 3, feeds the pipe onto the sinker chain assembly. The star wheel drive 22, the feeder conveyor 13, the sinker chain assemblies 1, 2, and 3 (only sinker chain assembly 2 shown in FIG. 3), and the screw roll assemblies 4 and 5 are all commonly driven in synchronization.

The components of a sinker chain assembly can best be seen by referring to FIGS. 3 and 4. Each assembly is comprised of an upper sprocket 27 and a lower sprocket 28 located at opposite ends of the assembly; a continuous chain 29 extending about the sprockets; a plurality of equally spaced separating dogs 30 extending from the continuous chain 29 and a fixed outer confinement strip 31 also called a saddle guide mounted to the pot 14 and extending from the top of the pot 14 to a predetermined liftout point A. As shown in the various figures, confinement strip 31 has a curvilinear configuration which basically follows the contour of a chain assembly.

Each of the sinker chains, although commonly driven, operate at different speeds to accomplish a sloping and resloping of the pipe during its descent into the bath and its ascent from the bath. This is accomplished by varying the pitch diameter of the sprockets of the various chain assemblies. This then varies the respective diametral pitches. The total number of pitches of the chain are also varied accordingly. The revolutions per minute of the sprocket shafts are constant but the lineal speed of the chains varies with the pitch diameter of the sprocket. The result is that the chain of chain assembly 1 is driven faster than the chain of chain assembly 2 which, in turn, is driven faster than the chain of chain assembly 3, but all are driven in synchronization. The synchronization is such that the inclination of the pipe is reduced to zero at its bottommost point of travel and then resloped during its ascent to the liftout point. This is schematically shown in FIG. 5.

The alignment of the parallel screw roll assemblies 4 and 5 to the sinker chain assemblies 1 and 2 can best be illustrated by referring to FIGS. 6 and 7. Each screw roll assembly 4 and 5 is aligned and adjacent to the lower end of the chain assembly at the predetermined liftout point A. Each screw roll assembly is comprised of two adjacent and offset screw rolls, 6 and 7 for screw roll assembly 4, and 8 and 9 for screw roll assembly 5. The screw rolls 6 and 8 which receive the pipe from the dogs 30 have a conical-shaped root and a variable double-pitch flight. The variable double-pitch flight as used herein describes a screw roll having a series of threads in two separate flights. The helix angle is always constant and thus the pitch is variable and decreases as the thread moves up toward the top of the cone root. As will be seen, one flight ends at a spiral contoured cam kickout where the pipe is transferred to the adjacent screw roll. The remaining flight continues above this transfer point and thus represents a single flight above this point. Of course, variations in flight design can be incorporated to accomplish the same result.

In the preferred embodiment, the longer screw rolls 6 and 8 of the respective screw roll assemblies 4 and 5 are positioned in relationship to the sinker chains so that the lowest threads of each of the double flights of the respective screw rolls are immediately below the liftout point A so that these respective lowest threads of the respective flights actually lift the pipe lengths from the dogs of the chain and then proceed to move the pipe lengths up the flight of the screw rolls. The adjacent and shorter screw rolls 7 and 9 which are offset from screw rolls 6 and 8, respectively, also have a conical-shaped root but each has only a single variable pitch flight.

The shorter flights of the screw rolls 6 and 8 end at spiral contoured cam kickouts 33 and 34, respectively. These kickouts represent the flights' ends and are spiral contour shaped to conform to the largest pipe diameter to be employed. At this kickout, the pipe is transferred to the adjacent screw rolls 7 and 9, having a single flight which then moves the pipe along its flight. The longer flight of screw rolls 6 and 8 bypass the transfer point where screw rolls 7 and 9 receive the pipe and thus continue the pipe along their own flight. Because the pipe is inclined at the liftout point A, one screw roll assembly is positioned higher in the bath than the other. This can best be seen by referring to FIG. 9. This then allows for the inclined pipe to be received simultaneously by the two screw roll assemblies. In addition, the pitches of the flights of the screw rolls of assembly 4 are greater than their respective pitches of the screw rolls of assembly 5. Since they are commonly driven, the speed of ascent varies depending on the pitch. The pitches of the flights are synchronized such that screw roll 6 receiving the upper end of the pipe moves faster than the screw roll 8 receiving the lower end of the pipe. This then increases the inclination over that which was present on the sinker chain at the time of removal. The purpose for this is to allow for better drainage of the molten zinc as it leaves the molten bath 24.

In FIG. 6 and FIG. 7, a flux baffle plate 59 which is standard equipment in a coating pot for molten zinc is shown. The only purpose of showing it is to indicate the ease an operator has in seeing the flux level on the flux baffle plate with our preferred embodiment.

A single elongated top confinement guide 56 which extends above and between the screw roll assemblies 4 and 5 serves as a guide for the pipe as they move up the single flight screw rolls 7 and 9 and up the single portion of the double-flight screw rolls 6 and 8. The placement of the top confinement guide can be seen in FIG. 2. An isometric of the confinement guide is shown in FIG. 13. The sections shown in FIG. 14 and FIG. 16 show the V-shape of the bottom of the guide. FIG. 15, which is also a section, shows the recess which allows the free movement of the threads of the screw rolls. FIG. 17, which is an end view looking from the left end to the right end of FIG. 13, shows the curvature of the sides which intersect to the V-portion of the guide. The curvature of the sides of the confinement guide as shown in FIG. 17 will properly confine pipe from one-half inch through 2 inches I.P.S. (Iron Pipe Sizes). The confinement guide then forms a guide path for the pipe as it moves up the screw rolls for delivery to alternate dragout conveyors.

In addition to the single elongated confinement guide 56, there are additional guides in the coating pot 14 and within the bath 24. Two such guides 57 and 58 are shown in FIG. 6 for screw roll assembly 4 and two more guides 60 and 61 are shown in FIG. 7 for screw roll assembly 5. All four guides are contoured in shape as shown. They act as additional confinement guides for the travel of the pipe. The guides 57 and 58 are placed on either side of screw roll assembly 4 whereas guides 60 and 61 are placed on either side of screw roll assembly 5. This manner of guide placement reenforces the guide path of the pipe and eliminates any possibility of unrestricted travel of the pipe.

Three of the four outer confinement strips 31 which form a part of the traveling compartments for the pipe add additional confinement at the liftout point A by means of a contoured lip on which the pipe travels during removal. The size and contour of the lip differs for each outer confinement guide as shown for lip 62 in FIG. 6 and lip 63 in FIG. 7. Referring to FIG. 5, the third confinement strip 31 from the exit end of the pot 14 which is the only confinement strip not immediately adjacent a sinker chain assembly does not have a lip at the liftout point. The reason is that that particular confinement strip is positioned at the pivotal point of the pipe, and the pipe actually has no lateral movement at that point. That is, as the pipe is removed from the sinker chains, it no longer is exactly parallel to the sides of the coating pot 14 and the confinement strip 31 without the lip is at that point about which the pipe pivots.

While the preferred embodiment shows conical-shaped screws, they are not absolutely necessary and the screws may be of various shapes such as curved or straight or combinations thereof. FIG. **8** shows an embodiment of the invention wherein the respective screw rolls **64** and **65** have straight roots rather than conical shaped. The straight rolls perform the same function and differ merely in physical shape.

An advantage of the conical root is that the conical shape takes up less space than a cylindrical root and, therefore, a smaller coating pot can be employed.

A screw roll assembly similar to that shown in FIG. **8** or the preferred embodiments could be employed having only single screw rolls with single or double flights. Two such assemblies could then be employed as a removal mechanism in a manner similar to that heretofore discussed.

Note than an alternate method of removing the pipe from the chain assembly to the screw assembly is also presented in FIG. **8**. Here a deflector plate **32** is shown pivotably mounted about pin **35** which attaches by suitable means to a chain assembly. The stop pin **36** limits the downward movement of the deflector plate **32** and thus keeps it in proper position to deflect pipe. It has been found that where two screw roll assemblies are employed, the preferred embodiment method of removing the pipe at the liftout point is superior to the deflector plate method of removing the pipe. However, the experiments run using two deflector plates and two screw roll assemblies indicated that the deflector plate method of removal would be quite satisfactory when used with a single screw roll assembly.

There are a number of equivalent ways of guiding the pipe up the screw rolls into the dragout conveyor. A series of guide plates can perform the same function as the continuous elongated confinement guide **56**. These guide plates would extend downwardly from support members of the framework. The guide plates should have the . V-type shape that the bottom portion of guide **56** has. If the outside diameters of the pipes employed in the process vary over wide ranges, the vertical guide plates can be made adjustable by any convenient method known to those skilled in the art to provide the proper size guide path.

FIGS. **10** and **11** show the arrangement of the feeder conveyor **13** as it is placing pipe on the star wheel **26** for subsequent placing onto the dogs **30** of a chain **29** of one of the sinker chain assemblies. The star wheel **26**, which is one of four identical star wheels as shown in FIG. **2**, places one pipe at a time onto the downwardly moving dogs of the chain. The star wheels are fed pipe by feeder conveyor **13** which is a chain conveyor having moving separating dogs. Such chain-type conveyors are common to those skilled in the art. Lug **51** is adjustable for different size pipe to control that only one pipe at a time is fed onto star wheels **26**. The star wheels and the feeder conveyor **13** are also driven in synchronization with the chain assemblies and the screw roll assemblies to allow for proper timing in the placement of the pipe for coating.

FIG. **12** shows the drive means. While the drive means is mechanically synchronized through variable speed motor **21**, it is apparent that the individual units could be separately driven and still operated in synchronization by electrical means well known to those skilled in the art. Note that FIG. **12** shows only the feed shaft **22**, the screw roll assemblies **4** and **5** and the sinker chain assemblies **1**, **2**, and **3** driven in synchronization. By similar means, the feeder conveyor and dragout means can also be driven by motor **21**. FIG. **12** shows variable speed motor **21** operably attached to shaft **38** by means of sprocket **37** and chain **52**. Shaft **38** drives screw roll assemblies **4** and **5** by means of operably adjacent sets of bevel gears **39** and **41** and **40** and **42**, respectively. Shaft **38**, in turn, is operably connected to shaft **43** by means of sprockets **53** and **44** and chain **45**. Shaft **43** has affixed thereto the upper sprockets **27** of the three sinker chain assemblies **1**, **2**, and **3**. Therefore, as shaft **43** is driven by motor **21**, so are the sinker chain assemblies. Shaft **43** is, in turn, operably connected to feed shaft **22** containing the star wheels **26** by means of sprockets **46** and **48** and chain **47**. Sprocket **48** is attached to one end of shaft **54** and spur gear **49** is attached to the other end. Operably adjacent spur gear **49** is spur gear **50** which is attached to the end of feeder shaft **22**. Feeder shaft **22** which contains universal joint **55** has affixed thereto the star wheels **26** which feed the sinker chains.

In addition to the preferred embodiment of our invention, there are a number of equivalent ways to continuously feed workpieces into and out of a process area and maintain the principle of first in-first out. Two other means of doing this are shown in the embodiments represented by FIG. **18** and FIG. **19**.

In FIG. **18**, the sinker chain assembly **66** is identical to the sinker chain assemblies in the preferred embodiment. While only one such sinker chain assembly is shown, it is to be understood that more than one sinker chain assembly is present as in the preferred embodiment. Of course, the sinker chains operate at different speeds via different chain pitches to obtain the sloping and resloping. The particular feed mechanism **67** is comprised of a series of synchronized feed wheels **68** which place the sloped pipe onto the dogs **69** of the chains **70** in a manner similar to the preferred embodiment.

The means for removing the workpiece from the sinker chains is comprised of a series of parallel and aligned reciprocating cradle assemblies **71** rather than two screw roll assemblies. Each cradle assembly extends downwardly from above the bath and is comprised of two parallel cradle arms **72** and **73** which have at their lower ends the actual cradles **86** and **87**, respectively.

The upper ends of the cradle arms **72** and **73** form racks which are operatively meshed to stationary pinion **75**. The pinion **75** is suitably mounted to the frame support **74**. The pinion **75** is driven by rack **84** which is connected to drive link **76** by means of connecting arm **77**. Drive link **76** is driven by shaft **85** which connects to the drive motor (not shown). The rotation of shaft **85** causes a camlike movement in drive link **76**. This, in turn, causes a substantially horizontal reciprocating movement of rack **84** which, in turn, is transferred to a substantially vertical reciprocating movement of cradle arms **72** and **73** through pinion **75**.

The reciprocation is such that the lowest point of travel of an individual cradle is calculated to occur at the predetermined liftout point A. The cradle portion of the cradle arms arrives at this position at the same time a pipe is being deflected from the chain dogs **69** by a hinged deflector plate **32**. The corresponding cradles of the other cradle assembly are likewise simultaneously receiving the pipe. Since the pipe is sloped at the removal point, the relative heights of the corresponding cradles of the cradle assemblies with respect to the bottom of the coating pot are in the same relationship as the inclination of the pipe so that the pipe is received simultaneously by all corresponding cradles. The cradle **86** of cradle arm **72** which is longer than the cradle **87** of cradle arm **73** is pivotably mounted to cradle arm **72** at point B by any suitable means. Therefore, as the cradle **87** is carrying pipe upward, cradle **86** which is being lowered pivots about point B when it contacts the ascending pipe and thus allows the pipe to continue upward unobstructed. When a pipe is placed on cradle **86** which is sloped toward pivot point B, the pipe is conveyed out of the path of travel of cradle **87**. As the pipe is being raised in corresponding cradles of the series of cradle assemblies, the remaining corresponding cradles are being lowered to receive the next pipe in the same manner. The pipe is then endwise removed from the cradle arms at the uppermost point of travel by any type of removal means, an example being the multiple parallel roll magnetic dragout conveyor **25** as employed in the preferred embodiment.

FIG. **19** shows a third embodiment of our invention which also performs the processing operation to insure the principle of first in-first out. In this embodiment, each sinker chain assembly is designed in the form of a right triangle. That is, instead of two sprockets in a vertical plane around which travels a continuous chain having dogs, there are three such sprockets

78, 79, and 80 with sprockets 78 and 79 in the same vertical plane and 79 and 80 in the same horizontal plane. Because of the angularity of the entry side of the sinker chain, the traveling compartments formed by the chain 81 and any two adjacent dogs 82 slant upwardly. This then enables one to manually or mechanically feed the pipe into the traveling compartments by merely sliding or pushing the pipe 10 on skids 83 from the entry conveyor. Of course, as in the other embodiments, curvilinear confinement strips which can be continuations of skids 83 complete the traveling compartments during movement through the bath. For purposes of completeness, a reciprocating cradle assembly, as previously described in FIG. 14, is shown as the removal means from the sinker chain.

It must be realized that where three sprockets are employed in a single chain assembly regardless of whether they are at right angles or in some other configuration, the rate of inclination of the pipe as controlled via different pitches of the sinker chains will be limited. This limitation will not be applicable to the extent that the pipe can be freely conveyed around any corner formed by the triangular configuration.

The two-sprocket chain assembly does not have this limitation and, therefore, this pipe can generally be inclined at a greater slope for better ease of entry and exit from the liquid bath.

The principle of first in-first out can also be employed without the benefit of either the screw roll assemblies or the reciprocating cradle assemblies. This is accomplished by merely not having the aforementioned removal means and manually removing the pipe lengths from the sinker chain assemblies after coating and after the chain assemblies themselves have conveyed the pipe out of the metal bath.

The operation of the preferred embodiment is as follows:

Cut length pipe 10 are deposited singly on inclined chain table conveyor 11 having spaced separating dogs. Chain table conveyor 11 conveys the pipe through a drying and preheating furnace 12. The pipe are discharged from the furnace from chain table conveyor 11 to chain table conveyor 13 also having spaced separating dogs. Chain table conveyor 13 is also inclined and thus conveys the cut pipe at a predetermined inclination to the star wheel arrangement of FIG. 10. The star wheels feed the pipe simultaneously to the dogs 30 of each of the three sinker chain apparatus 1, 2, and 3. The sinker chains, each of which has a different pitch for different synchronized lineal chain speeds, are provided with spaced dogs 30 which, together with fixed outer confinement strips 31, form traveling compartments for conveying individual lengths of pipe into the molten zinc suitably inclined to allow proper metal displacement and proper venting of air. These compartments assist in moving the pipe into the molten zinc which is slightly less dense than the steel pipe. Because of the different synchronized lineal speeds of the three sinker chains, the inclination of the pipe is reduced to zero as the sinker chains feed the pipe to its lowest depth. Again, because of the different synchronized lineal chain speeds, the pipe is resloped as it is fed away from its lowest point and toward its liftout point A.

At the predetermined liftout point A, the pipe is engaged by the lowest portion of the threads of the flights of screw rolls 6 and 8 which remove the pipe from the sinker chains and proceed to move the pipe along the flights of the screw rolls. The confinement of fixed outer confinement strip 31 is also ended at the liftout point A. A guide path is formed by the confinement strip 31, the upper lip, e.g. 62, of the confinement strip and lower deflector guides 57, 58, 60 and 61. This guide path properly restricts the movement of the pipe 10.

The receiving portion of screw roll 6 is positioned higher than the receiving portion of screw assembly 8 by a distance which allows both assemblies to receive the inclined pipe simultaneously. Each assembly (4 and 5), as shown earlier, has the receiving screw rolls (6 and 8, respectively) with variable double-pitched flights and the adjacent offset screw rolls (7 and 9, respectively) with a single flight. When a cut length of pipe is placed on the shorter of the two flights of screw rolls 6 and 8, it is moved up the flight to a predetermined point at which time the pipe is transferred to the flight of the adjacent aligned screw rolls 7 and 9, by means of spiral contoured cam kickouts 33 and 34 which form the ends of the shorter flights of the double flight screw rolls 6 and 8, respectively. The single flight screw rolls 7 and 9 continue to move the pipe both vertically and laterally until the pipe is brought into alignment with and under one of two parallel multiple rolls which form the start of the magnetic dragout 25. These rolls are continuous rotating, inclined magnetic dragout conveyors, well known to those skilled in the art, which remove the pipe from the screw rolls and the molten zinc baths by endwise motion. Since the respective pitches of the flights of the screw roll assemblies are different, as shown and discussed for FIGS. 6 and 7, the inclination of the pipe is appreciably increased for better drainage as it leaves the metal bath.

Similarly, when the cut length is placed onto the longer of the two flights of screw rolls 6 and 8, the pipe is not transferred, but instead is moved vertically and laterally until the pipe is moved to the second row of the parallel dragout conveyor rolls which form part of magnetic dragout 25. The pipe length regardless of which flight it travels in is always guided by the single elongated confinement guide 56.

It should be noted that the movement of the pipe with respect to each other in the coating pot is always parallel and longitudinal excepting minor endwise surges due to buoyancy effects. As such, there is no substantial endwise movement until the pipe is removed by the dragout rolls.

It can, therefore, be seen that if a cut length of pipe is placed in each chain pocket at the entry of the furnace, which will thus feed each chain pocket of the sinker chains, pipe will be discharged alternately at the two parallel dragout rolls of magnetic dragout 25. When pipe are loaded in every other pocket, the pipe will be removed by only one of the dragout conveyors.

While we have herein shown and described a preferred embodiment of our invention, it is recognized that departures may be made therefrom but that the invention will be accorded the full scope of the claims so as to embrace any and all equivalent devices.

We claim:

1. In a processing line for continuously processing elongated workpieces by the lateral movement from a conveying means at a preparation station to a process area for the workpieces and subsequently to conveying means for delivery to a finishing station, the improvement comprising:

A. Transfer means at the preparation station for accepting and inclining workpieces; and

B. Sinker means adjacent to the transfer means and extending substantially vertically into the process area and having an operable transport means to continuously receive inclined workpieces from the transfer means, and convey the workpieces downwardly into the process area and upwardly for removal from the process area.

2. The apparatus of claim 1 wherein the sinker means comprises at least two spaced, parallel, and aligned chain assemblies operated in synchronization by a drive means such that when a lower end of the inclined workpiece is received by a dog of one chain assembly, an upper end of the inclined workpiece is simultaneously received by a dog of another chain assembly; the synchronized chain assemblies operating such that the chain transporting the upper end of the workpiece is traveling faster than the chain transporting the lower end so that the workpiece is still inclined when it enters the process area, the inclination being reduced to zero at a lowermost point of travel and the workpiece being resloped during ascent, the workpiece being held in place by traveling compartments formed by a chain, adjacent dogs, and a fixed outer confinement strip.

3. In a processing line for continuously processing elongated workpieces by the lateral movement from a conveying means at a preparation station to a process area for the workpieces

and subsequently to a dragout means for delivery to a finishing station, the improvement comprising:

A. Transfer means at the preparation station for accepting and inclining workpieces;

B. Sinker means adjacent to the transfer means and extending substantially vertically into the process area and having an operable transport means to continuously receive inclined workpieces from the transfer means, and convey the workpieces downwardly into the process area and upwardly for removal from the process area; and

C. Removal means positioned adjacent to the lower end of the sinker means and having a first conveying section extending within the process area to receive a processed workpiece from the transport means and at least a second conveying section extending from the process area to a dragout means for subsequent delivery to a finishing station.

4. The apparatus of claim 3 wherein the sinker means comprises at least two spaced, parallel, and aligned chain assemblies operated in synchronization by a drive means such that when a lower end of the inclined workpiece is received by a dog of one chain assembly, an upper end of the inclined workpiece is simultaneously received by a dog of another chain assembly; the synchronized chain assemblies operating such that the chain transporting the upper end of the workpiece is traveling faster than the chain transporting the lower end so that the workpiece is still inclined when it enters the process area, the inclination being reduced to zero at a lowermost point of travel and the workpiece being resloped during ascent, the workpiece being held in place by traveling compartments formed by a chain, adjacent dogs, and a fixed outer confinement strip.

5. The apparatus of claim 3 wherein the removal means comprises a least two spaced and aligned, synchronized screw roll assemblies positioned to receive simultaneously an inclined workpiece, each screw roll assembly including at least a first screw roll and a second offset screw roll wherein the first screw roll has at least a first and second flight having a portion of the flights immediately adjacent the sinker means for removing the workpiece from the sinker means and the second screw roll has at least a single flight for receiving workpieces from at least one flight of the first screw roll.

6. The apparatus of claim 3 wherein the removal means comprises at least two parallel cradle assemblies each assembly having two parallel reciprocating cradle arms with cradles extending therefrom, said assemblies operated in synchronization such that corresponding cradles of the parallel assemblies receive the workpiece between its ends simultaneously from the sinker means and deliver the workpiece to the dragout means.

7. An apparatus in a continuous process line for receiving inclined elongated workpieces and conveying them downwardly into and upwardly from a process area, comprising at least two spaced, parallel and aligned chain assemblies, each chain assembly having sprocket means located at opposite ends of the assembly, a continuous chain extending about the sprocket means, a plurality of spaced separating dogs extending from the continuous chain, and a fixed outer confinement strip suitably mounted from a point of entry of the workpiece and extending to a point of exit of the workpiece; the chain assemblies operated in synchronization by a drive means attached to the sprocket means, whereby the inclined workpiece is received simultaneously by dogs of the chain assemblies; the synchronization being such that a chain transporting an upper end of the workpiece travels faster than a chain transporting a lower end so that the workpiece is still inclined when it enters the process area, the inclination being reduced to zero at a lowermost point of travel and the workpiece being resloped during ascent, the pipe being held in place by traveling compartments formed by the chain, adjacent dogs, and the fixed outer confinement strip.

8. In a continuous process line an apparatus for removing elongated workpieces from a sinker means in a process area and for conveying the workpieces to a dragout means, the apparatus comprising a cradle assembly having at least two parallel cradle arms with cradles extending therefrom extending substantially vertical from above the process area into the process area and immediately adjacent the sinker means, the cradle arms being affixed by suitable means to a drive means which imparts a substantially vertical reciprocating motion to the cradles so that as one cradle is being lowered, another cradle is being raised, the cradles positioned so that at a lowest point of travel of a cradle, the workpiece is deflected off the sinker means onto the cradle, the cradle then delivering the workpiece to the dragout means while simultaneously another cradle is being lowered in position to receive a next workpiece.

9. The apparatus of claim 8 wherein the apparatus comprises at least two parallel cradle assemblies having corresponding cradle arms and cradles operated in synchronization whereby the corresponding cradles of the parallel assemblies simultaneously receive the workpiece between its ends and deliver the workpiece to the dragout means.

10. An apparatus for removing elongated workpieces from sinker means in a process area and for conveying the workpieces to a dragout means, comprising at least two spaced, parallel and aligned screw roll assemblies adjacent a lower end of at least two sinker means; each screw roll assembly including at least a first screw roll and a second offset screw roll wherein the first screw roll has at least one of a straight, conical and curved root and at least a first and second flight having a portion of the flights immediately adjacent the sinker means for removing the workpiece from the sinker means and which will upon receiving the workpiece on the first flight, convey it vertically and laterally to the dragout means and which will upon receiving the workpiece on the second flight convey it to the second screw roll having at least one of a straight, conical and curved root and at least one flight for receiving the workpiece and for also conveying it vertically and laterally to the dragout means; the screw roll assemblies being synchronized to receive simultaneously the workpiece between its ends.

11. The apparatus of claim 10 wherein apparatus comprises one screw roll assembly whereby the workpiece is received between its ends.

12. The apparatus of claim 10 wherein any pitch along a flight of each screw roll in a given screw roll assembly differs from a respective pitch along a flight of a corresponding screw roll in another screw roll assembly whereby the difference in pitch causes one end of the workpiece to ascend faster than the other end.

13. The apparatus of claim 10 wherein each screw roll assembly is comprised of a single screw roll having one of a straight, curved and conical root and at least one flight for conveying workpieces both vertically and laterally to a dragout station.

14. In a processing line for treating elongated round workpieces having at least a pair of screw roll assemblies, each assembly having two screw rolls angularly offset from each other, a guide comprising in combination therewith an elongated member having a substantially V-shaped portion throughout its length which is positioned adjacent the angular offset of the screw rolls, said member having sides which form the V-shaped portion, said sides having a curvature to accommodate the round workpieces and forming a pair of guide paths, each guide path formed between a side of the member and a screw roll of each screw roll assembly.

15. The guide apparatus of claim 14 wherein the guide is a series of parallel and substantially vertical, V-shaped plates affixed in spaced-apart relationship to support members of the processing line, said guides having the V-shaped sides adjacent the angular offset of the screw rolls, said guides forming a pair of guide paths between the screw rolls of each pair of screw roll assemblies and the guide sides.

16. The guide apparatus of claim 15 wherein the guide plates are adjustable by adjusting means to form varying size guide paths for varying size workpieces.

17. An apparatus in a continuous processing line for receiving workpieces and conveying them downwardly into and upwardly from a process area, comprising at least two spaced, parallel, aligned chain assemblies, each chain assembly comprised of an upper sprocket above the process area and two lower sprockets within the process area wherein the three sprockets form the points of a triangle, a continuous chain extending about the sprockets, a plurality of spaced separating dogs extending from the continuous chain and a fixed outer confinement strip extending from a point of entry of the workpieces to a point of exit, whereby the chain, adjacent dogs and confinement strip form traveling compartments for the workpieces, said traveling compartments slanting upward for ease in receiving workpieces on the receiving side of the chain assembly.

18. The apparatus of claim 17 wherein the sprockets of each assembly form the points of a right triangle.

19. The apparatus of claim 17 wherein the chains of the chain assemblies travel at different speeds in synchronization to alter the inclination of the workpiece during movement into and out of the process area.

20. A continuous method of consecutively handling a plurality of elongated workpieces into, through and out of a process area wherein the first workpiece in the process area is the first workpiece out of the process area and successive workpieces can be handled in the same manner and simultaneously with preceding workpieces comprising:

A. Receiving at a position adjacent the process area a first workpiece inclined from the horizontal;

B. Lowering the inclined workpiece into the process area while simultaneously reducing the inclination;

C. Leveling the workpiece to a horizontal position at a lowermost point of travel in the process area; and

D. Removing the workpiece from the process area while simultaneously reinclining it.

21. The method of claim 20 wherein the workpieces with respect to each other are handled through the process area in parallel and longitudinal relationship thusly eliminating substantially all endwise movement.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,559,794 Dated February 2, 1971

Inventor(s) William M. McConnell et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 5, Column 9 Line 35 --a-- should read --at--

Claim 20, Column 12 Lines 14 and 15

The claim should read as follows:

-- D. Raising the workpiece in the process area from the lowermost point of travel while simultaneously reinclining it; and

E. Removing the workpiece from the process area while simultaneously substantially increasing the workpieces' inclination. --

Signed and sealed this 8th day of June 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents